COAL ASSESSMENT REPORT TITLE PAGE AND SUMMARY

TITLE OF REPORT: **Coal assessment report for the Willow Creek coal lease -- Volume 2: Willow West area**

TOTAL COST: **$2,542,545.55**

AUTHOR(S): **C.G. Cathyl-Huhn, L.R. LeMay, and P. Singh**

SIGNATURE(S):

NOTICE OF WORK PERMIT NUMBER(S)/DATE(S):

YEAR OF WORK: **2011 and 2012**

PROPERTY NAME**: Willow Creek**

COAL LICENSE(S) AND/OR LEASES ON WHICH PHYSICAL WORK WAS DONE:
Coal Lease 389294

MINERAL INVENTORY MINFILE NUMBER(S), IF KNOWN: **93O.008**

MINING DIVISION: **Liard**

NTS / BCGS**: NTS 93O/9 / BCGS 93O.059 and 93O.069**

LATITUDE: **55° 35' 33.3" North**; LONGITUDE: **122° 14' 18.1" West** (at centre of work)

UTM Zone: **10N** EASTING: **548000** NORTHING: **6161000**

OWNER(S): **Pine Valley Coal Ltd.**

MAILING ADDRESS: **235 Front St. (P.O. Box 2140), Tumbler Ridge, BC, V0C 2W0**

OPERATOR(S) [who paid for the work]: **Willow Creek Coal Partnership**

MAILING ADDRESS: **235 Front St. (P.O. Box 2140), Tumbler Ridge, BC, V0C 2W0**

REPORT KEYWORDS (lithology, age, stratigraphy, structure, alteration, mineralisation, size and attitude). **coal, Minnes Group, Bickford Formation, Bullhead Group, Cadomin Formation, Gething Formation, Gaylard Member, Bluesky Formation, Moosebar Formation, Bullmoose Member, Chamberlain Member, Cowmoose Member, anticlines, synclines, thrust faults**

REFERENCES TO PREVIOUS ASSESSMENT WORK AND ASSESSMENT REPORT NUMBERS: **Coal Assessment Reports 526, 667, 861, and 972; Petroleum Report 863; B.C. Oil and Gas Commission Well Report 15660**

SUMMARY OF TYPES OF WORK IN THIS REPORT		EXTENT OF WORK (in metric units)	ON WHICH TENURES
GEOLOGICAL (scale, area)			
	Ground, mapping	**nil**	
	Photo interpretation	**nil**	
GEOPHYSICAL (line-kilometres)			
	Ground (Specify types)	**nil**	
	Airborne	**nil**	
	(Specify types)		
	Borehole		
	Gamma-density	**9,379.02 metres**	**389294**
	Resistivity	**9,379.02 metres**	**389294**
	Caliper	**9,379.02 metres**	**389294**
	Deviation	**8.741.7 metres**	**389294**
	Dipmeter	**nil**	
	Others **(gamma-neutron)**	**8,547.26 metres**	**389294**
	Core drilling	**nil**	
	Non-core (rotary) drilling of **53 boreholes**	**9,692.85 metres**	**389294**
SAMPLING AND ANALYSES			
Total number of samples		**nil**	
	Proximate	**nil**	
	Ultimate	**nil**	
	Petrographic	**nil**	
	Vitrinite reflectance	**nil**	
	Coking	**nil**	
	Wash tests	**nil**	
PROSPECTING (scale/area)		**nil**	
PREPARATORY/PHYSICAL			
Line/grid (km)		**nil**	
Trench (number, metres)		**nil**	
Bulk sample(s):		**nil**	

1 Table of contents

1.1 List of tables

1.2 List of maps

2 Introduction

The Willow West block comprises the southeasterly portion of a larger coal lease (the Willow Creek coal lease, covered by Crown tenure 389294, with an overall area of 6151 hectares). The Willow Creek coal lease, although held as one tenure, has been in recent years explored and developed as three distinct blocks, although these blocks do not have independent identities as mineral tenures in their own right:

- Willow West block, the subject of the present report;
- Willow South block, situated along the northeastern bank of Willow Creek, and thus lying to the east-northeast of Willow West; and
- Willow Creek block, situated further north along the northeastern bank of Willow Creek, and thus lying to the east and northeast of Willow West.

Each of these blocks are to be reported within a three-volume series of coal-assessment reports, presenting a comprehensive discussion of geology, current exploratory activity, coal-quality investigations, and geophysical data, placed within the context of an updated geological map.

To reiterate, this report (the second of three volumes in the series) concerns the Willow West block. As such, current exploration comprises rotary-drilling and associated downhole geophysical surveys, conducted in years-2011 and 2012. No disturbant work has subsequently been done at Willow West, to the date of writing in late May of 2015. Records of pre-2011 exploration are presented in the previously-submitted Coal Assessment Report No.861, by James (1998).

Current work comprises drilling of 53 boreholes (all as non-coring rotary-holes) and an ancillary programme of downhole geophysical surveys (as documented in **Appendix A** of this report).

Near-surface sedimentary rocks within and adjacent to the Willow West block are of Lower Cretaceous age, comprising (from youngest to oldest) the basal two formations of the Fort St. John Group, and the entirety of the Bullhead Group. The older Minnes Group is inferred to underlie the Willow West block, but it is not mapped at outcrop at any point, and it likely has not yet been reached by drilling within the block. Coal has been extensively drilled within the Gaylard Member of the Gething Formation of the Bullhead Group (**Map 2-3; Table 3-1**). Younger rocks, of the remainder of the Fort St. John Group, the Dunvegan Formation, and the yet-younger Alberta Group, were almost certainly originally-present at Willow West, but these rocks have been stripped away by erosional processes.

Willow West's coals have not been worked by any historic, nor current, coal-mining operations. The closest mining operations, workshops and other support facilities are at Walter Energy's presently-idled Willow Creek Colliery, situated immediately east of the Willow West block. A coal-washery and rail-loader are situated at Willow Creek.

Other than the coals which have been the focus of exploratory activities within the Willow West block, associated sedimentary rocks comprise conglomerates, sandstones, siltstones, mudstones, carbonaceous mudstones, concretionary ironstone, accompanied by thin but distinctive bands of igneous tuff. Marine mudstones and siltstones occur within the Fort St. John Group (Wickenden and Shaw, 1943; Hughes, 1963). The local occurrence of bioturbated mudstones and siltstones in the basal half of the Gething Formation's Gaylard Member hints at the presence of marine conditions during deposition. The facies of the majority of the Gaylard Member, and also of the underlying Cadomin and Bickford formations, are otherwise fluvial.

Bedrock within the Willow West block is moderately-deformed, possibly less-so than is the case in the adjoining Willow Creek and Willow South blocks (James, 1998; Jordan and Acott, 2005). Northeast-verging thrust-faults, some of which may be folded, and associated northwest-striking, northeast-verging folds predominate at Willow West. These folds are most commonly associated with southwest-verging thrust-faults, which themselves are likely to be folded owing to passive deformation above subsequent underlying thrusts. The northeast vergence of the Willow West structures is consistent with the regional norm within the Foothills of northeastern British Columbia.

Within the Gaylard coal-measures, numerous coal zones have been found by historic and current drilling at Willow West. Coal zones are numbered in downward succession from the No.1 (near the top of the coal-measures) through No.12, following a long-established schema (McKechnie, 1955). As well, a coal zone at the immediate top of the coal-measures has been given the local name of Bird Seam, although this coal is by no means correlative with the Bird Seam as previously-recognised in other coal properties of northeastern British Columbia.

Most of the coal zones contain one or more major coal beds, often associated with laterally-branching splits, stringers and stringer plies (as summarised in **Table 5-1**). Individual coal beds and sub-beds range in thickness from a few decimetres to several metres.

At Willow West, as in several other areas within the Mink-Brazion coalfield, the Gaylard coal-measures may be conveniently subdivided into five informal divisions, numbered in upward succession from Division 1 at the base of the Gaylard, to Division 5 at the top of the Gaylard. Drilling has established that the thickest, and possibly more laterally-extensive, coals occur within Division 2 of the Gaylard Member, at Willow West.

Regional correlations of Gaylard coals are here proposed, although not examined in detail:

- No.4 zone at Willow West may be correlative with the Brenda Seam at Hasler Creek, F zone at Mink Creek, Seam C60 at Burnt River, and the Lower Gething B zone at Sukunka;
- No.6 zone at Willow West may be correlative with the Upper Seam at Burnt River; and
- No.7 zone at Willow West may be correlative with the Lower Seam at Burnt River.

Coal-resource studies have been commenced, as concerns the Willow West block, but no formal report is known to have yet been issued.

2.1 Scope of report

This report has been compiled and submitted by Willow Creek Coal Partnership (WCCP) in keeping with the provisions of the *Coal Act* and the *Coal Act Regulation*, with respect of exploratory activities on Crown coal tenures within British Columbia.

This report documents exploratory work completed on the Willow West block of WCCP's Willow Creek coal lease, situated within the Mink-Brazion coalfield, in the northeastern part of British Columbia. WCCP's current exploratory work was conducted in years-2011 and 2012, with the drilling of 53 boreholes at Willow West. No subsequent physical work has been done at Willow West.

2.2 Situation and objectives

The Willow Creek coal lease, and the Willow West block thereof, are located in the Peace River region of northeastern British Columbia (**Map 2-1**), an area which has seen considerable coal-exploration activity since the late 1960s.Walter Energy Inc., and predecessor and associated firms such as Willow Creek Coal Partnership, have for some years operated metallurgical-coal mines within this area.

From 1975 onward, the Willow West block has been drilled for coal. This majority of this work was done in years-2011 and 2012, and hence is considered as 'current' and therefore reportable exploratory work, as documented in **Appendix A** of the present report.

No oil and gas wells have yet been drilled within the Willow West block, although several 'conventional' exploratory wildcat wells have been drilled within a few tens of kilometres of the block, and a coalbed gas well (with geological synopsis presented in **Appendix A**) has been drilled a half-kilometre west of the block.

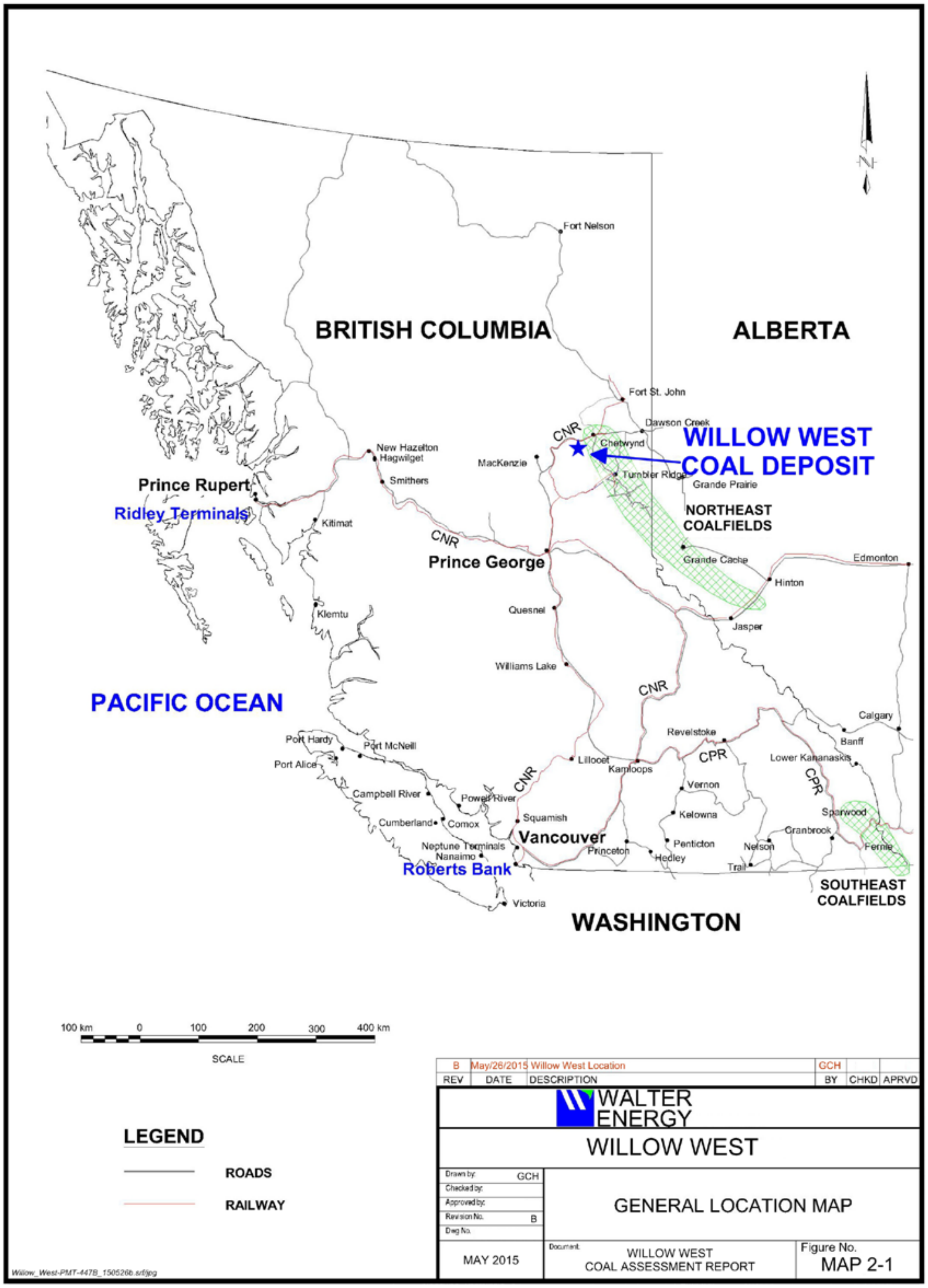
2.3 Property description

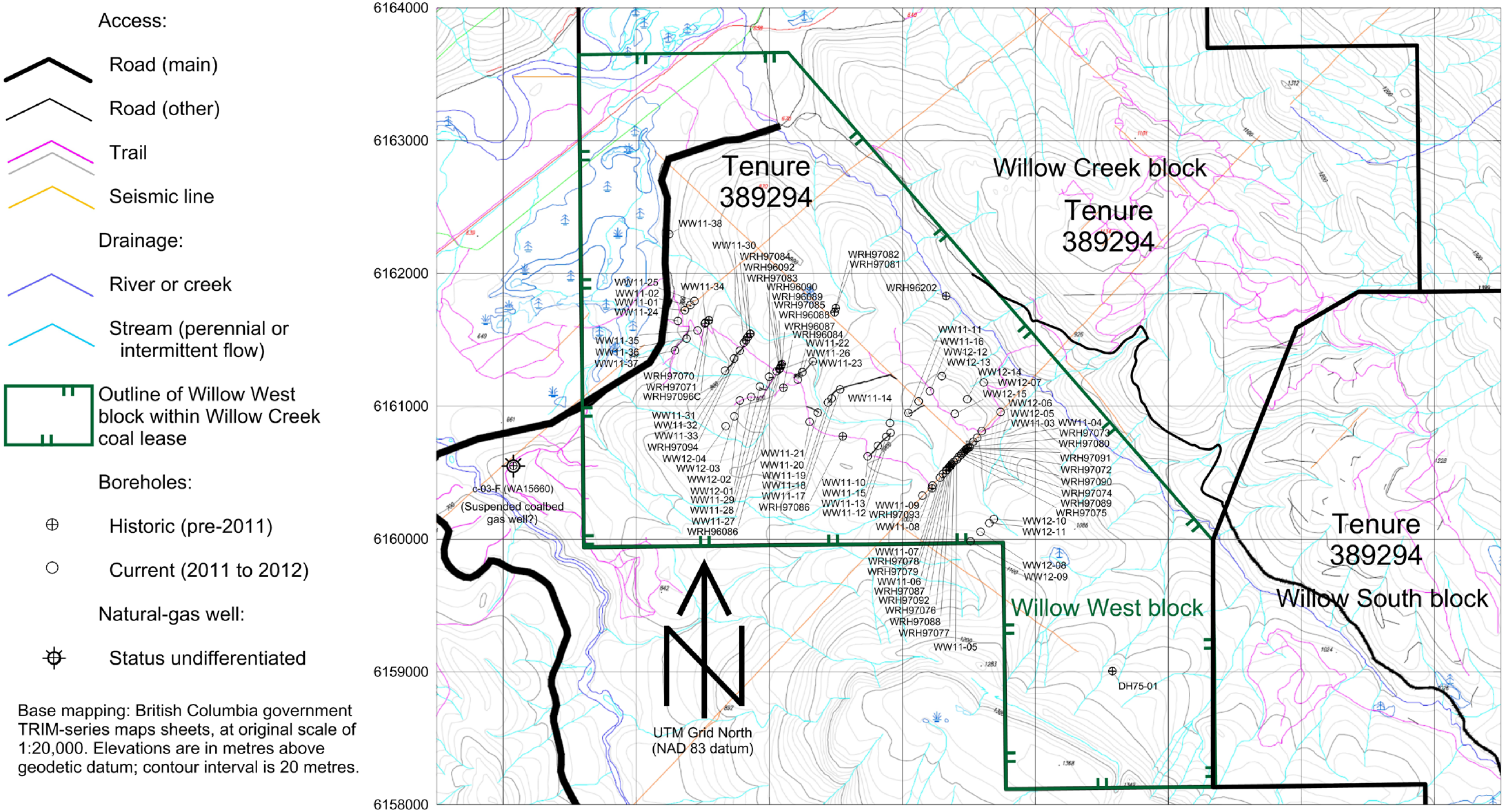
The Willow West block occupies the western portion of the Willow Creek coal lease (Tenure 389294), within the Liard Mining District of northeastern British Columbia, situated within the eastern half of map-area 93O/9 of Canada's National Topographic System. The aggregate area of the Willow Creek coal lease is 6151 hectares. Tenure 389294 was granted by the Crown on March 31, 1998 (as listed in **Table 2-1**).

Table 2-1: Tenure details of the Willow Creek coal lease

Tenure Number	Map	Block	Units	Date Acquired	Area (hectares)	Former coal lease number
389294 (84 units)	93O/9E	B	61, 62, 63, 64, 71, 72, 73, 74, 81, 82, 83, 84, 85, 86, 87, 88 91, 92, 93, 94, 95, 96, 97, 98	March 31, 1998	6151	Coal Lease 15
	93O/9W	F	1, 2, 11, 12, 21, 22, 31, 32 41, 42, 51, 52, 61, 62, 63, 64 71, 72, 73, 74, 83, 84, 93, 94			
	93O/9E	G	3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 17, 18, 19, 20, 25, 26, 27, 28, 29, 30, 35, 36, 37, 38, 39, 40, 47, 48, 49, 50, 57, 58, 59, 60			
Totals:	1 tenure		84 units		6,151 hectares	

Note: Map sheets listed are within the National Topographic System. Blocks and Units refer to the British Columbia Coal Tenures Grid System, whose unit cells are based upon NAD 27 surveys, and translated into NAD 83 coordinates for purposes of mapping.


BRITISH COLUMBIA
ALBERTA
PACIFIC OCEAN
WASHINGTON
WILLOW WEST
COAL DEPOSIT
NORTHEAST
COALFIELDS
SOUTHEAST
COALFIELDS
Fort Nelson
Fort St. John
Dawson Creek
Chetwynd
Tumbler Ridge
Grande Prairie
Grande Cache
Hinton
Edmonton
Jasper
MacKenzie
New Hazelton
Hagwilget
Smithers
Prince Rupert
Ridley Terminals
Kitimat
Prince George
Quesnel
Klemtu
Williams Lake
CNR
CPR
Revelstoke
Calgary
Banff
Lower Kananaskis
Port Hardy
Port McNeill
Port Alice
Campbell River
Powell River
Lillooet
Kamloops
Vernon
Kelowna
Penticton
Sparwood
Cranbrook
Fernie
Nelson
Trail
Hedley
Princeton
Squamish
Vancouver
Cumberland
Comox
Neptune Terminals
Nanaimo
Roberts Bank
Victoria
100 km 0 100 200 300 400 km
SCALE
LEGEND
ROADS
RAILWAY
B May/26/2015 Willow West Location GCH
REV DATE DESCRIPTION BY CHKD APRVD
WALTER
ENERGY
WILLOW WEST
Drawn by: GCH
Checked by:
Approved by:
Revision No. B
Dwg No.
GENERAL LOCATION MAP
MAY 2015
Document: WILLOW WEST
COAL ASSESSMENT REPORT
Figure No.
MAP 2-1
Willow_West-PMT-447B_150526b.srf/jpg

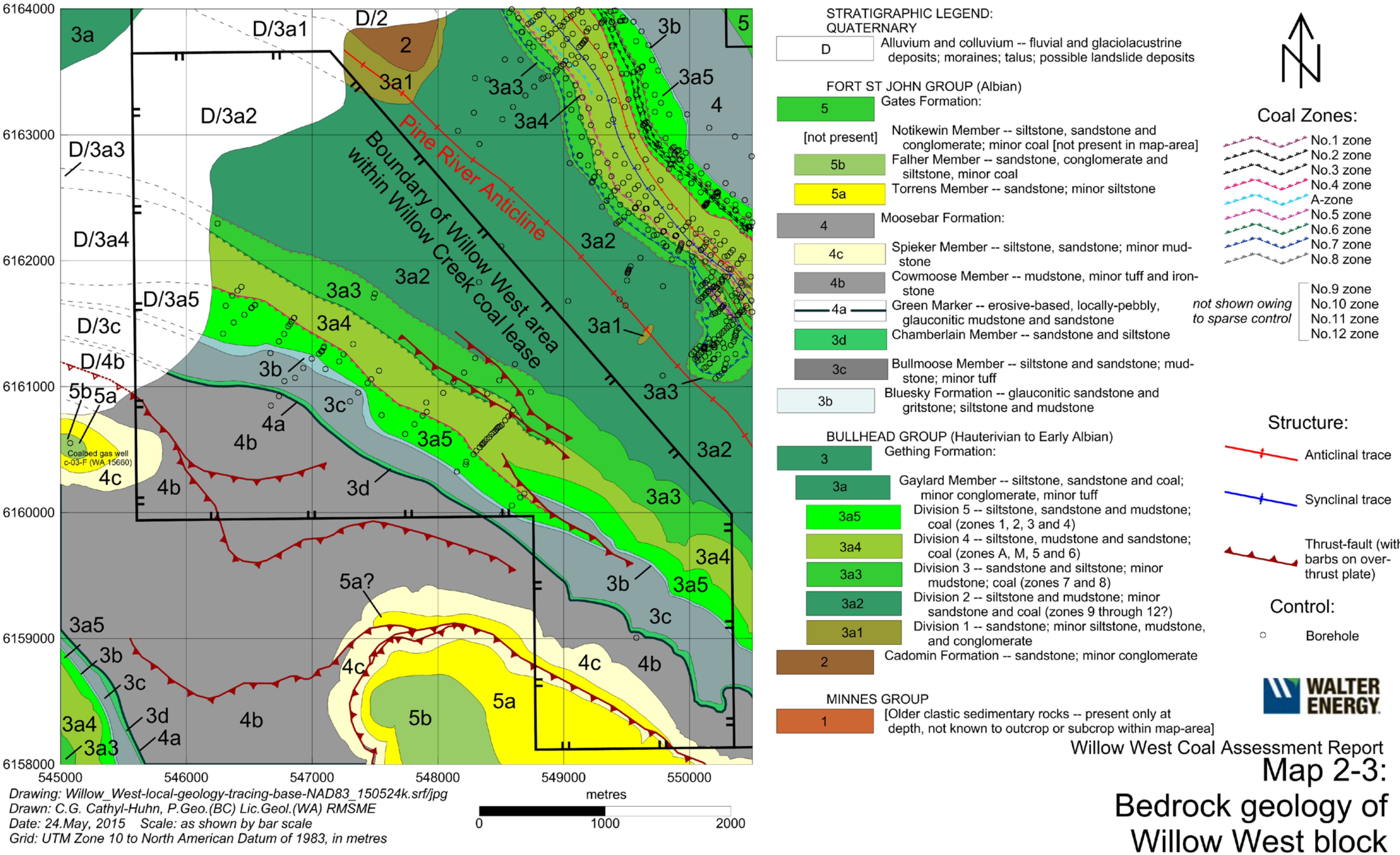


Drawing: Willow_West-topography_150515c.srf/jpg
Drawn: C.G. Cathyl-Huhn, P.Geo.(BC) Lic.Geol.(WA) RMSME
Date: 15.May, 2015   Scale: as shown by bar scale
Grid: UTM Zone 10 to North American Datum of 1983, in metres

metres
0 1000 2000 3000

WALTER ENERGY

Willow West Coal Assessment Report
Map 2-2:
Coal Tenure and Topography



Pine River Anticline
Boundary of Willow West area within Willow Creek coal lease
Coalbed gas well c-03-F (WA 15660)
6164000
6163000
6162000
6161000
6160000
6159000
6158000
545000
546000
547000
548000
549000
550000
metres
0
1000
2000
Drawing: Willow_West-local-geology-tracing-base-NAD83_150524k.srf/jpg
Drawn: C.G. Cathyl-Huhn, P.Geo.(BC) Lic.Geol.(WA) RMSME
Date: 24.May, 2015 Scale: as shown by bar scale
Grid: UTM Zone 10 to North American Datum of 1983, in metres
STRATIGRAPHIC LEGEND:
QUATERNARY
D Alluvium and colluvium -- fluvial and glaciolacustrine deposits; moraines; talus; possible landslide deposits
FORT ST JOHN GROUP (Albian)
5 Gates Formation:
[not present] Notikewin Member -- siltstone, sandstone and conglomerate; minor coal [not present in map-area]
5b Falher Member -- sandstone, conglomerate and siltstone, minor coal
5a Torrens Member -- sandstone; minor siltstone
4 Moosebar Formation:
4c Spieker Member -- siltstone, sandstone; minor mudstone
4b Cowmoose Member -- mudstone, minor tuff and ironstone
4a Green Marker -- erosive-based, locally-pebbly, glauconitic mudstone and sandstone
3d Chamberlain Member -- sandstone and siltstone
3c Bullmoose Member -- siltstone and sandstone; mudstone; minor tuff
3b Bluesky Formation -- glauconitic sandstone and gritstone; siltstone and mudstone
BULLHEAD GROUP (Hauterivian to Early Albian)
3 Gething Formation:
3a Gaylard Member -- siltstone, sandstone and coal; minor conglomerate, minor tuff
3a5 Division 5 -- siltstone, sandstone and mudstone; coal (zones 1, 2, 3 and 4)
3a4 Division 4 -- siltstone, mudstone and sandstone; coal (zones A, M, 5 and 6)
3a3 Division 3 -- sandstone and siltstone; minor mudstone; coal (zones 7 and 8)
3a2 Division 2 -- siltstone and mudstone; minor sandstone and coal (zones 9 through 12?)
3a1 Division 1 -- sandstone; minor siltstone, mudstone, and conglomerate
2 Cadomin Formation -- sandstone; minor conglomerate
MINNES GROUP
1 [Older clastic sedimentary rocks -- present only at depth, not known to outcrop or subcrop within map-area]
Coal Zones:
No.1 zone
No.2 zone
No.3 zone
No.4 zone
A-zone
No.5 zone
No.6 zone
No.7 zone
No.8 zone
not shown owing to sparse control
No.9 zone
No.10 zone
No.11 zone
No.12 zone
Structure:
Anticlinal trace
Synclinal trace
Thrust-fault (with barbs on over-thrust plate)
Control:
Borehole
WALTER ENERGY
Willow West Coal Assessment Report
Map 2-3:
Bedrock geology of Willow West block

To reiterate, the Willow West block is an informal operational subdivision of the coal lease, with no formal stand-alone identity within the Crown mineral-tenure system of British Columbia. The outline of the Willow West block is depicted upon **Map 2-2** and **Map 2-3** of the present report. The following mineral tenure grid-units cover the extent of the Willow West block:

- Map-sheet 93O/9 Block B: Units 87, 88, 97, and 98.
- Map-sheet 93O/9 Block F: Units 1, 2, 11, 12, 21, 22, 31, and 32.
- Map-sheet 93O/9 Block G: Units 8, 9, 10, 19, 20, and 30; and southwestern halves of Units 7, 18, 29, and 40.

2.4 Location and access

Chetwynd town, located on Highway 97 and situated approximately 50 kilometres northeast of Willow West, is the closest incorporated settlement to Willow West (**Map 2-1**). Chetwynd's population was reported as 2,633 persons in the year-2006 census. In the context of more-distant communities within British Columbia, the Willow West coal property is located 130 kilometres south of Fort St John, 95 kilometres west of Dawson Creek, and 315 kilometres northeast of Prince George. Vancouver is situated 730 kilometres to the south-southwest of the property. Commercially-scheduled aircraft flights connect Vancouver to Fort St. John.

A coal-loading facility is situated on the southern bank of the Pine River, 5 kilometres to the northeast of Willow West. This loadout site, which fills railway cars with coal produced from Brule Mine and from the Willow Creek coal washery, allows rail access to ports along the Pacific Coast of Canada, and elsewhere within the North American railway network. CN Rail are the operator of the former BC Rail line to which the loadout site is connected.

2.5 Climate

The nearest climate station to Willow West is at Chetwynd, with 'cool continental' climate of frigid winters and warm summers. Average annual rainfall and snowfall at Chetwynd are 306 millimetres and 169 centimetres respectively. The average frost free period ranges between 84 to 91 days, and about 30 foggy days are expected per year. The mean daily temperature at Chetwynd is 15.4 C in July and -10.7 C in January. Winter temperatures below -40C are not uncommon, with the coldest weather occurring in January and February of most years.

2.6 Landforms and forest cover

The Willow West block lies within the Inner Foothills of the Rocky Mountains. Topography comprises deeply-dissected, steep-sided, rounded hills and mountains, with elevations ranging from 635 to 1368metres above sea level. Topographic contours at 20-metre intervals, based upon provincial government mapping (TRIM map-sheets 93O.059 and 93O.069), are shown in **Map 2-2**.

The Willow West block lies within the Sub-Boreal Interior ecoprovince, within which are three biogeoclimatic ecosystem classification variants:

- Boreal White and Black Spruce moist warm Peace variant (BWBSmw1),
- Sub-boreal Spruce wet cool Finlay-Peace variant (SBSwk2), and
- Englemann Spruce Subalpine Fir moist very cold Bullmoose variant (ESSFmv2).

The Willow West block is heavily forested, chiefly with lodgepole pine, trembling aspen, balsam poplar, white and black spruce, and tamarack. The property lies within Tree Farm Licence 48, part of the Dawson Creek Timber Supply Area. Some cut-blocks have been operated for timber harvesting within the Willow West block. As a result, forest cover exhibits a range of ages and states of maturity.

2.7 Acknowledgements and professional responsibility

Thanks are due to many past and present workers:

- Dr. Muzaffer Sultan P.Geo. at Walter Energy, and Ian MacLeod P.Geo. at Peace River Coal (formerly a Walter Energy employee involved in Willow West drilling), who provided details of the year-2011 and 2012 drilling programmes.
- Laura LeMay B.Sc., and Preetpal Singh M.A.Sc., both at Walter Energy, who compiled borehole records and many of this report's data tables.
- Dr. Peter Jones, at International Tectonic Consultants, who has continued to offer thought-provoking insights into the structural geology of the Mink-Brazion coalfield, including the Pine River Anticlinorium and the thrust-faults associated with the Falls Mountain klippe.
- Sara McPhail P.Geo. and David Richardson P.Geo., at the B.C. Ministry of Natural Gas Development, who assisted in locating details of gas wells including the c-03-F coalbed gas well.
- Blake Snodsmith, at Jim Walter Resources, who provided a regional TRIM base-map, from which the topographic base of **Map 2-2** was derived.

Gwyneth Cathyl-Huhn P.Geo. (BC) Lic.Geol. (WA) RMSME accepts professional responsibility for data and conclusions presented within this report.

3 Exploration

Both historic (pre-2011) and current (year-2011 and 2012) coal exploration has been done by various parties within the Willow West segment of the Willow Creek coal lease. The vast majority of the work is of current vintage. The author of the present report, whilst in the employ of a third party, briefly visited the Willow West property as part of a regional structural and coal-quality survey, in the summer of 1981.

3.1 History of exploration

The following discussion is adapted mainly from an unpublished report for Unicorn International Mines Group Inc. (Ryan, 2010).

Coal was first discovered in the Peace River District in 1793, by Alexander MacKenzie's exploring expedition (MacKenzie, 1801). Prior to 1980, less than 100,000 tonnes of coal were mined at all locations within northeastern British Columbia (Ryan, 2002).

At a location on Hasler Creek, situated about 17 kilometres southeast of Willow West, the Hasler Creek Coal Company commenced small-scale underground coal-mining in 1943, continuing through 1944 and 1945. At this time, considerable geological mapping and some prospecting were undertaken within the Pine River Anticlinorium, including the Willow West area (Wickenden and Shaw, 1943, Spivak, 1944, Stott, 1973).

From 1946 onward to 1951, British Columbia's former Department of Mines conducted a diamond-drilling and trenching programme of the then-known coal deposits near the Pine River valley (McKechnie, 1955). This programme appears to have extended into the Willow West block, but logs of boreholes have not yet been located, although they might eventually be found within the working files of the British Columbia Geological Survey Branch.

In the late 1950s, several oil companies undertook structural and stratigraphic mapping within and adjacent to Willow West, and within the Mink-Brazion coalfield generally. A report done for Triad Oil, by Dr. Peter Jones (1960) is the most useful of those reports which are publicly-available. In 1963, Dr. John Hughes compiled a dissertation for McGill University, concerning structural geology and tectonics of the Pine River valley, including the Willow West area (Hughes, 1963). Dr. Hughes' work was sponsored by the then-extent British Columbia Department of Mines, leading to the publication of two provincial Geological Survey Bulletins (Hughes, 1964; 1967).

The expansion of steel production in mid-1960s stimulated exploration for metallurgical coking coal. By the mid-1970s within northeastern British Columbia, most of the land with coal potential had been acquired by mining companies, or by oil and gas companies seeking to enter the coal industry as a means of diversification. Initial development interest was along the existing railway (then known as the British Columbia Railway) which passed through Pine Pass and thus connected Chetwynd and Dawson Creek with then-existing ports along British Columbia's western coast.

Interest in coal development increased with rapid increase in crude oil prices, and concomitant increase in coal prices. These price increases were followed in short order by the signing of a joint government-industry agreement between Japan and Canada, to develop new coal mines, highways, railways, other infrastructure, and a workers' townsite at Tumbler Ridge. Shipments of northeastern British Columbia coal through a new port at Ridley Island (near

Prince Rupert, British Columbia) commenced in 1984, and have continued to the present day, albeit at currently-reduced levels owing to the present depression in global coal prices.

The Geological Survey of Canada published a regional-scale structural synthesis (McMechan, 1984), consisting of a map and cross-section at a scale of 1:250,000, followed by a journal article concerning the geometry of thrust-faults (McMechan, 1985).

In all, 35 historic boreholes (as reported in previous coal-assessment reports, and cited within **Section 10** of the present report), totalling at least 1210.32 metres' length, have been drilled at Willow West. Note that the total of historic boreholes does not include holes which may have been drilled by the British Columbia Government (McKechnie, 1955) between 1946 and 1951 -- this issue is still being examined, and copies of detailed logs have been requested from the British Columbia Geological Survey Branch.

As well, results of the 53 current (years-2011 and 2012) boreholes, totalling 9692.85 metres' length, are here-reported for the first time, with geophysical logs (**Table A-1**) and major coal intersections (**Table A-2**) presented in **Appendix A** of this report.

Historic and current drilling at Willow West, within the northwestern and central parts of the block, is regarded as having validly tested the coal potential (but not the coal quality -- see below) of the coal-measures of the Gaylard Member of the Gething Formation. Drilling is still relatively sparse within the southeastern segment of the block, where untested exploratory potential remains.

Only one historic coal-quality control point has been found thus far, from borehole WRH97096C, where a composite sample taken from one coal bed was found to have non-agglomerating characteristics. No current coal-quality data are available; this leads to the conclusion that the coal quality characteristics of the Willow South block are essentially unknown.

Table 3-1: Historic (pre-2011) coal exploration boreholes

Borehole	*UTM (NAD83, Zone 10)*		*metres*				
	Easting	Northing	Elevation	Total depth	Data source	Year	Drilling Method
Year 1975							
DH75-01	549578	6159006	1149	198.42	CAR-526	1975	Rotary
Year 1996							
WRH96084	547104.87	6161140.16	905	41.98	WW96-97nad83	1996	Rotary
WRH96085	*not drilled?*						
WRH96086	547075.689	6161279.508	897.35	*unknown*	97WRHsor	1996	Rotary
WRH96087	547095.17	6161318.4	884.1	35	WW96-97nad83	1996	Rotary
WRH96088	547089.999	6161306.119	887.07	17		1996	Rotary
WRH96089	547078.2	6161285.46	894.53	35	WW96-97nad83	1996	Rotary
WRH96090	547073.83	6161278.73	897.35	30	WW96-97nad83	1996	Rotary
WRH96091	*not drilled?*						
WRH96092	546854.5	6161544	856.24	33	WW96-97nad83	1996	Rotary
WRH96202	548328	6161829	781	38		1996	Rotary
Year 1997							
WRH97070	546515.88	6161621.95	775.61	30	97WRHsor	1997	Rotary
WRH97071	546546.31	6161648.85	774.84	18	97WRHsor	1997	Rotary
WRH97072	548476.32	6160672.99	1015.22	30.49	97WRHsor	1997	Rotary
WRH97073	548505.16	6160692.9	1020.3	40	97WRHsor	1997	Rotary
WRH97074	548455.1	6160648.31	1019.43	20	97WRHsor	1997	Rotary
WRH97075	548425.44	6160620.59	1021.78	30	97WRHsor	1997	Rotary
WRH97076	548361.31	6160551.21	1017.91	30	97WRHsor	1997	Rotary
WRH97077	548387.49	6160581.88	1017.14	30	97WRHsor	1997	Rotary
WRH97078	548305.598	6160489.949	1019.1	*unknown*	97WRHsor	1997	Rotary
WRH97079	548331.14	6160519.57	1018.35	30	97WRHsor	1997	Rotary

Table 3-1: Historic (pre-2011) coal exploration boreholes (concluded)

Borehole	*UTM (NAD83, Zone 10)*		*metres*				
	Easting	Northing	Elevation	Total depth	Data source	Year	Drilling Method
WRH97080	548493.67	6160684.54	1019.75	23	97WRHsor	1997	Rotary
WRH97081	547489.91	6161708.13	883.61	24.86	97WRHsor	1997	Rotary
WRH97082	547498.75	6161737.46	885.47	30	97WRHsor	1997	Rotary
WRH97083	546856.74	6161546.36	856.24	30	97WRHsor	1997	Rotary
WRH97084	546836.8	6161519.21	857.54	35	97WRHsor	1997	Rotary
WRH97085	547095.38	6161318.41	884.23	20	97WRHsor	1997	Rotary
WRH97086	547552.06	6160774.3	966.84	20	97WRHsor	1997	Rotary
WRH97087	548348.5	6160537.94	1021.54	23	97WRHsor	1997	Rotary
WRH97088	548370.65	6160563.39	1016.28	28	97WRHsor	1997	Rotary
WRH97089	548443.24	6160635.76	1021.12	20	97WRHsor	1997	Rotary
WRH97090	548465.58	6160659.95	1018.33	30	97WRHsor	1997	Rotary
WRH97091	548484.89	6160679.8	1017.92	30	97WRHsor	1997	Rotary
WRH97092	548355.86	6160545.76	1020.06	20	97WRHsor	1997	Rotary
WRH97093	548221.37	6160381.92	1017.84	30	97WRHsor	1997	Rotary
WRH97094	546824.69	6161497.12	854.14	30	97WRHsor	1997	Rotary
WRH97096C	546544.77	6161647.48	774.84	129.57	WW96-97nad83	1997	Core
Totals	35 boreholes; > 1210.32 metres						
Year 2001 (coalbed gas well -- off property to west)							
c-03-F (WA15660)	545076.19	6160550.94	705.1	595.8	B.C. Oil and Gas Commission files	2001	Rotary/Core

Data sources: 97WRHsor and WW96-97nad83 are survey data files found on Vancouver engineering computer; B.C. Oil and Gas Commission files are records concerning Well Authorisation No.15660. CAR-526 is Coal Assessment Report No.526. Records of boreholes WRH96086 and WRH97078, other than their positions, are missing, although empty file folders were located in Vancouver office files.

3.2 Current (year-2011 and year-2012) exploration

Willow Creek Coal Partnership conducted rotary-drilling programmes within the Willow West block in years-2011 and 2012. No coring was done in either year. **Tables 3-2** and **A-1** summarise the drilling and geophysical details of these boreholes.

Access to drill sites was generally via a combination of existing and new trails, including reactivated logging trails where they were conveniently located with regard to the desired drilling locations. Some drill-pads were built immediately adjacent to existing high-grade roads.

The purpose of the drilling was to test the Gaylard Member coal-measures for potentially-mineable coal seams, to assess the lateral continuity of the coal beds, and to provide a preliminary indication of coal quality. The drilling mainly examined the coals of zones No. 4, No.5, No. 6, and No.7, within the middle portion of the Gaylard Member. Stratigraphically-higher coals of zones 1 through 4, and of A-zone, were drilled less-intensively, and minimal attention was paid to coal zones 8 through 12. The M-coals, as had been found at Willow South, were apparently not found at Willow West.

A summary of major coal-beds intersected within current boreholes is presented as **Tables A-2** and **A-3**, within **Appendix A**.

3.2.1 Borehole geophysics

Downhole geophysical logging of all of the current boreholes was done by Century Wireline Services in year-2011 and 2012. A standard coal-industry suite of logs was run:

- Gamma/caliper/resistivity/density;
- Gamma/density through drill rods (as an expedient; uncalibrated);
- Gamma/neutron; and
- Deviation/verticality.

Dipmeters were not run in either year. Digital and/or scanned copies of resultant downhole geophysical logs are presented in **Appendix A**, with an inventory of logs as **Table A-1**.

3.2.2 Current coal-quality work

Owing to lack of coring or other sampling, no current coal-quality work was done.

Table 3-2: Current (year-2011 and 2012) coal-exploration boreholes

	UTM (NAD83, Zone 10)		*Collar*	*Total*			*Drilling*
Borehole	*Easting*	*Northing*	*Elevation*	*depth*	*Azimuth*	*Dip*	*method*
Year-2011							
WW11-01	546365.952	6161722.371	697.185	201.16	40.5	-60.7	Rotary
WW11-02	546406.605	6161761.412	715.554	158.49	37	-60.2	Rotary
WW11-03	548561.197	6160762.58	994.19	176.78	185.8	-89.7	Rotary
WW11-04	548533.66	6160732.899	1008.665	128.01	224	-59.5	Rotary
WW11-05	548407.441	6160597.847	1020.353	210.31	44.2	-59.8	Rotary
WW11-06	548332.334	6160517.534	1017.777	170.68	43.1	-55.8	Rotary
WW11-07	548282.75	6160462.327	1020.729	201.16	42.4	-56.5	Rotary
WW11-08	548226.069	6160403.826	1015.658	201.16	43	-54.5	Rotary
WW11-09	548151.062	6160326.155	1004.671	234.69	37.7	-58.5	Rotary
WW11-10	547739.764	6160622.542	990.968	213.36	63	-60.1	Rotary
WW11-11	548042.821	6160950.038	996.584	201.16	44.8	-61.3	Rotary
WW11-12	547911.9	6160800.445	992.101	158.49	36.8	-61	Rotary
WW11-13	547878.78	6160769.632	994.304	170.69	42.8	-59.2	Rotary
WW11-14	547907.514	6160873.179	984.89	195.07	41	-60.3	Rotary
WW11-15	547814.454	6160701.205	988.961	179.83	56.5	-59.7	Rotary
WW11-16	548122.581	6161037.644	1008.018	152.4	266.3	-89.3	Rotary
WW11-17	547533.122	6161126.178	952.259	146.3	272.8	-58.4	Rotary
WW11-18	547469.354	6161059.4	933.153	146.3	50.3	-57	Rotary
WW11-19	547440.214	6161027.833	925.319	112.77	42	-57.7	Rotary
WW11-20	547364.258	6160952.992	937.953	202.38	40.2	-57.1	Rotary
WW11-21	547302.569	6160882.24	954.949	249.93	33	-52.5	Rotary
WW11-22	547214.703	6161200.673	925.137	109.72	41	-59.8	Rotary
WW11-23	547326.531	6161338.256	895.815	228.6	40	-59.4	Rotary
WW11-24	546313.049	6161642.846	689.311	222.5	44	-56.7	Rotary
WW11-25	546437.708	6161793.24	727.372	124.96	43.4	-57	Rotary
WW11-26	547249.677	6161256.573	914.357	161.54	35.1	-58.5	Rotary
WW11-27	547055.842	6161262.29	893.69	161.54	45.5	-57.9	Rotary
WW11-28	546997.946	6161221.718	876.801	185.92	38.6	-58.2	Rotary
WW11-29	546928.79	6161147.986	868.733	228.6	39.2	-57.4	Rotary
WW11-30	546809.481	6161478.166	848.239	185.92	38.5	-55.9	Rotary
WW11-31	546667.938	6161266.709	792.946	207.32	45.8	-58.3	Rotary
WW11-32	546735.662	6161358.973	801.019	225.61	39	-58.8	Rotary
WW11-33	546777.888	6161418.456	831.288	192	44.8	-56.2	Rotary

Table 3-2: Current (year-2011 and 2012) coal-exploration boreholes (concluded)

WW11-34	546520.752	6161629.15	775.137	207.3	43.7	-59	Rotary
WW11-35	546461.661	6161571.036	745.518	152.44	44.9	-59.3	Rotary
WW11-36	546377.205	6161510.132	719.609	192.02	39.6	-59.2	Rotary
WW11-37	546291.428	6161420.099	697.106	216.46	33.4	-55.5	Rotary
WW11-38	546247.839	6162295.292	671.332	200.09	41.3	-58.1	Rotary
Year-2012							
WW12-01	546864.588	6161070.137	875.322	158.54	43.7	-57.6	Rotary
WW12-02	546779.06	6161042.761	870.191	207.26	44.9	-58.6	Rotary
WW12-03	546736.724	6160924.317	889.597	210.31	35.1	-58	Rotary
WW12-04	546672.855	6160849.808	855.402	182.88	42.3	-60.6	Rotary
WW12-05	548596.338	6160812.157	987.929	164.59	40.6	-61.6	Rotary
WW12-06	548738.467	6160957.051	935.57	173.73	38.7	-60.4	Rotary
WW12-07	548612.09	6161177.84	901.842	146.3	40.3	-60.5	Rotary
WW12-08	548588.62	6160055.123	1062.933	175.26	44.9	-58.8	Rotary
WW12-09	548511.149	6159983.617	1070.934	219.68	39.2	-57	Rotary
WW12-10	548687.446	6160150.647	1035.78	246.88	45.4	-57.9	Rotary
WW12-11	548653.577	6160120.66	1049.451	174.65	43	-60	Rotary
WW12-12	548207.531	6161112.061	1002.802	150.32	0	-90	Rotary
WW12-13	548297.417	6161226.982	995.724	150.28	0	-90	Rotary
WW12-14	548487.445	6161051.058	1011.514	143.86	223	-75	Rotary
WW12-15	548393.448	6160942.41	1024.11	174.65	47.5	-88.3	Rotary
Totals: 53 boreholes, 9692.85 metres							

Note: table compiled by Preetpal Singh, from survey data lists, geophysical-log headers, and downhole verticality survey data.

4 Geological setting

The coalfields of northeastern British Columbia are hosted by marine and non-marine clastic sediments of Jurassic, Cretaceous and earliest Tertiary age. These rocks form a series of thick sequences of molasse and flysch, all of which was deposited into the Rocky Mountain Foreland Basin of Western Canada. The basin is bounded by the mobile crustal terranes of the Cordilleran Orogen to the west, and the cratonic rocks and Palaeozoic cover sequences of the Canadian Shield to the east.

4.1 Regional structural setting

Most of the Jura-Cretaceous sediments were derived from orogenically-uplifted landmasses lying to the southwest of the basin, although patterns of sedimentation were to some extent influenced by occasional vertical movements of underlying structures within the cratonic basement rocks, chief amongst which was the Peace River Arch (Stott, 1968).

During Late Mesozoic and Early Cenozoic time, the Cordilleran Orogen underwent two main phases of deformation: the Late Jurassic to earliest Late Cretaceous Columbian Orogeny, and the Late Cretaceous to Oligocene Laramide Orogeny (Douglas *et al*, 1970). Both of these orogenies were driven by transpressional crustal movements along the outboard (western) edge of the North American continent. In each case, orogenic activity was driven by the collision of northward-moving exotic crustal terranes, which in turn caused compressive strains within the previously-accreted western margin of the continent. Northeast-directed overthrusting of Palaeozoic rocks caused episodic uplift of the Cordilleran Orogen, in turn providing a ready source of sediment into the Foreland Basin (Cant and Stockmal, 1989; Cant, 1996; Cant and Abrahamson, 1996).

The present-day Rocky Mountains are the most visible manifestation of Columbian and Laramide overthrusting, which gradually proceeded northeastward, with successively-younger thrusts tending to break through the Foreland's rocks at successively-deeper stratigraphic levels. As successively-younger thrusts developed, they generated passive folding within overlying, previously-deformed rocks. Overlying, older thrusts were therefore passively folded along with their adjoining strata. Recognition of folded thrusts is essential to understanding the structural geology of the Foothills coal deposits of northeastern British Columbia.

From southwest to northeast, the Cordilleran fold-thrust belt gradually changes structural styles (Thompson, 1979) from a thrust-dominant regime(within the mostly-Palaeozoic carbonate-clastic rocks of the Rocky Mountain Main Ranges and Front Ranges) to a mixed fold-thrust regime (within the Inner Foothills, including the Willow West property) to a gently-folded frontal regime (within the Outer Foothills, five to ten kilometres to the northeast of Willow West).

4.2 Regional stratigraphic setting

Stratigraphic nomenclature within the coalfields of northeastern British Columbia has undergone considerable revision during the past fifty years. Principal workers, whose reports were used as primary references for the present report, are J.E. Hughes (1964, 1967), D. Stott (1968, 1973, 1981, 1998), P.McL.D. Duff and R.D. Gilchrist (1981), and D.W. Gibson (1992).

The stratigraphic sequence within the northwestern part of the Mink-Brazion coalfield (including Willow West) comprises Lower Cretaceous rocks of the Fort St. John and Bullhead groups, and older Jurassic to Lower Cretaceous rocks of the Minnes Group (**Table 4-1**). Fort St.

John Group rocks are present only along the northeastern and southwestern fringes of the Willow West block, owing to substantial erosion. Minnes Group rocks are present only in the subsurface at Willow West, inasmuch as the Bullhead Group rocks are nowhere completely stripped-away by erosion (**Map 2-3**). Almost all of the block is covered with coal-measures of the Gaylard Member of the Gething Formation, which forms the upper part of the Bullhead Group.

Considerable stratigraphic controversy (as expressed in works of Hughes and Stott) has revolved around the identity and stratigraphic topology of rocks underlying and overlying the coal-measures of the Gething Formation. In this report, the Gething Formation, as well as immediate sub-Gething rocks, are assigned to the Bullhead Group, following Stott's extensive regional work.

At the latitude of the Willow West block, and within the Pine Pass area in general, only the Gaylard Member of the Gething Formation contains coal of potentially-mineable thickness, although within the nearby Burnt River property (McClymont, 1981; Cathyl-Huhn and Avery, 2014b), the Chamberlain Member (there the uppermost subdivision of the Gething Formation) also appears to be coal-bearing.

Owing to the general southwestward back-stepping of the Gething paleodelta complex, at Willow West the Bluesky is recognised as a formation in its own right (homotaxial with the more-extensive Bluesky sediments within the Deep Basin of the Alberta Syncline), and the Bullmoose and Chamberlain members (elsewhere assigned to the Gething Formation) are both considered to be members of the Moosebar Formation, as neither the Bullmoose rocks nor the Chamberlain rocks manifest any non-marine indicators. Supra-Gething rocks (from the Bluesky Formation upwards) are assigned to the Fort St. John Group, following Stott's work.

4.3 Local structural geology

Structural geology of the Willow West area would be difficult to decipher on the sole basis of bedding attitudes within exposed bedrock, owing to the isolated nature of the outcrops. Much of our understanding of local structural geology comes from borehole intersections of coal-measures, supplemented by isolated exposures of bedrock alongside roads and trails. An additional source of structural information, albeit indirect, is from the interpretation of landforms as visible in aerial photographs and on detailed topographic maps, although this indirect observation is locally hampered by Drift cover.

Map 2-3 depicts, in <u>general</u> terms, our understanding of bedrock structure at property scale. Willow West comprises a southwest-dipping monoclinal panel of coal-measures and cover rocks, dislocated by northeast-verging thrust-faults. The Willow West block occupies the trailing (southwestern) limb of the Pine River Anticlinorium, together with an isolated thrust-floored erosional remnant (a klippe, *sensu* Eisbacher, 1996) of cover rocks capping Falls Mountain. Willow West's coal-measures are therefore considered likely to occupy a deeper structural position within the core of the triangle-zone (McMechan, 1984; 1985; Lingrey, 1996) than Willow South or the Willow Creek mine itself.

Subsidiary folds are likely present within the Willow West block, as they have been mentioned in passing within available exploratory records. No attempt has been made to trace such structures across the Willow West lands depicted within **Map 2-3**, on account of incomplete structural interpretation.

Normal stratigraphic sequences are generally preserved at Willow West, despite the thrust-faulting of the rocks and concomitant tectonic stacking. Overturned strata appear to be rare, or perhaps non-existent, although this determination is clouded by the angled geometry of most exploratory boreholes.

4.4 Local stratigraphy

Based largely upon the interpretation of downhole geophysical logs of coal-exploration boreholes and of the c-03-F coalbed gas well, the following stratigraphic sequence (as shown in **Table 4-1**) has been identified within and adjacent to the Willow West block.

Table 4-1: Table of formations and subdivisions

<table>
<tr><th colspan="3">Group/Formation/Member</th><th>Map-unit</th><th colspan="3">Lithology and thickness</th></tr>
<tr><td colspan="3">Quaternary Drift</td><td>D</td><td colspan="3">Alluvium; lodgement till; moraines; talus; glaciolacustrine silts, up to ?150 m thick within Pine Valley.</td></tr>
<tr><td rowspan="8">Fort St. John Group</td><td rowspan="2">Gates Fm.

50 to 60 m thick (incomplete)</td><td>Falher Mb. (incomplete)</td><td>5b</td><td>Sandstone, conglomerate and siltstone; minor coal; only basal 10 to 20 m present, entirely outside property boundary</td><td colspan="2">Presence of coal not yet proven within/near Willow West block</td></tr>
<tr><td>Torrens Mb.</td><td>5a</td><td>Sandstone; minor siltstone; ca. 40 m thick</td><td colspan="2">Unlikely to contain coal</td></tr>
<tr><td rowspan="5">Moosebar Fm.</td><td>Spieker Mb.</td><td>4c</td><td>Siltstone, sandstone; minor mudstone; 60 to 90 m thick</td><td colspan="2" rowspan="2">May be locally structurally-thickened owing to thrust-induced telescoping</td></tr>
<tr><td>Cowmoose Mb.</td><td>4b</td><td>Mudstone; minor tuff and ironstone; 80 to 100 m thick</td></tr>
<tr><td>Green Marker</td><td>4a</td><td>Erosive-based basal glauconitic mudstone, sandstone and grit; 0.4 to 1 m [too thin to map separately at property scale]</td><td colspan="2" rowspan="2">Locally repeated by thrusting</td></tr>
<tr><td>Chamberlain Mb.</td><td>3d</td><td>Sandstone and siltstone; 4 to 8 m thick</td></tr>
<tr><td>Bullmoose Mb.</td><td>3c</td><td>Siltstone and sandstone; mudstone; minor tuff; ca. 100 m thick (generally thickened)</td><td colspan="2">Frequently structurally-thickened owing to thrust-induced telescoping</td></tr>
<tr><td colspan="2">Bluesky Fm.</td><td>3b</td><td colspan="3">Glauconitic sandstone, siltstone, mudstone, and gritstone; 4 to 16 m</td></tr>
<tr><td rowspan="6">Bullhead Group</td><td rowspan="5">Gething Fm.</td><td rowspan="5">Gaylard Mb.</td><td rowspan="5">3a</td><td rowspan="5">Numerous fining-upward cycles of sandstone, siltstone, mudstone and coal (zones 1 through 10); minor tuff; local concentration of sandstone beds; 260 to 360? metres thick (generally thickened by thrust-induced telescoping) ; thickness of sub-units variable and not yet well-established</td><td>3a5</td><td>Siltstone, sandstone, mudstone and coal (zones 1 through 4); minor tuff</td></tr>
<tr><td>3a4</td><td>Siltstone and mudstone; coal (zones A, 5 and 6)</td></tr>
<tr><td>3a3</td><td>Sandstone; minor siltstone and mudstone; coal (zones 7 and 8)</td></tr>
<tr><td>3a2</td><td>Siltstone and mudstone; minor sandstone and coal (zone 9)</td></tr>
<tr><td>3a1</td><td><u>Basal sandy unit</u>: sandstone and siltstone; minor coal (zones 10 to 12 -- correlations tentative)</td></tr>
<tr><td colspan="2">Cadomin Fm.</td><td>2</td><td colspan="3">Gritty to pebbly, siliceous sandstone and sandy conglomerate with distinctive 'blocky' gamma-log response; minor siltstone and coal; thickness unknown; erosional base</td></tr>
<tr><td>Minnes Group</td><td colspan="2"></td><td>1</td><td colspan="2">Siltstone, sandstone, conglomerate, and mudstone; minor coal; ca. 1000-1200 m thick</td><td>present only at depth beneath the property</td></tr>
</table>

Relationships between the various rock-units that occur within and adjacent to the Willow West block are shown on the geological map (**Map 2-3**) accompanying this report. **Map 2-3** incorporates results of current drilling, together with historic drilling and geological mapping done by others, as cross-referenced in **Section 10** of this report. Geological contacts shown on the map are approximate to inferred, owing to the generally-discontinuous nature of bedrock exposures, and paucity of documented stratigraphic and structural fieldwork.

Rock-units are discussed in detail below, in order from youngest (generally nearest the ground surface) to oldest. Localised inversions of stratigraphic position have been induced by thrust-faulting, but the overall stratigraphic relations remain readily-recognisable, owing to distinctive geophysical and lithological characteristics of the various rock-units.

4.5 Drift

Unconsolidated sediments, inferred to be of Quaternary age, form a patchy blanket at the ground surface throughout the Willow West block. For reasons of clarity, Drift is not mapped as a separate entity within **Map 2-3**, except along the floor of the Pine River valley.

The most pervasive Drift cover consists of glacial till, usually less than 10 metres thick. Patches of sandy, gravelly and bouldery alluvium are present within stream channels. McKechnie (1955) noted the presence of possibly-glaciolacustrine silt deposits within the southeastern portion of the Willow South area; although an extension of such deposits into Willow West is considered likely, the extent of such deposits has yet to be assessed in detail, owing to lack of lithological records in Drift-penetrating boreholes.

The Pine River valley is inferred to be floored and possibly flanked by valley-filling alluvial, glacial, and glaciolacustrine sediments. By inference with results of sparse drilling in other valleys within the Foothills of northeastern British Columbia, such deposits are inferred to be locally up to 150 metres thick.

4.6 Fort St. John Group (map-units 5, 4, and upper part of map-unit 3)

The uppermost of the Early Cretaceous rocks of the Fort St. John Group have been completely removed by erosion at Willow West. Most of this erosion is likely to have occurred during a prolonged episode of regional uplift during the Tertiary era (Cant and Stockmal, 1989), followed by further glacial scouring during the Quaternary era, and continuing through fluvial down-cutting to the present time. Within the Group, the remainder of its constituent formations remain at least locally-present within the Willow West map-area. From top down, these are the Gates, Moosebar and Bluesky formations.

4.6.1 Gates Formation (map-units 5b and 5a)

The Gates Formation, of late Early Albian age within the Early Cretaceous, comprises thin to thick interbeds of sandstone, siltstone, conglomerate, and shale, locally accompanied by coal beds. Coals of the Gates Formation, and their enclosing sedimentary rocks, were deposited on the shoreline of the Clearwater Sea (part of the Western Interior Seaway) between 108.7 and 111.0 million years ago, as part of an extensive complex of coastal plains, deltas and estuaries collectively known as the Gates Delta.

At Willow West, the basal part of the Gates Formation is present within the upland area of Falls Mountain, in the southeastern corner of the property. No boreholes have penetrated the Gates Formation within the Willow West property, but its coal potential is expected to be low on account of the well-established northward diminishment of coal content within the formation.

Regionally, the Gates Formation may be readily subdivided into three members: the uppermost, dominantly fine-grained Notikewin coal-measures (completely removed by erosion within the Willow West map-area), the medial, dominantly coarse-grained conglomeratic Falher coal-measures (map-unit 5b, of which the basal 10 to 20 metres has been preserved), and the basal Torrens sandstone (map-unit 5a, 30 to 40 metres thick?). The Notikewin, Falher and Torrens members can be reasonably-distinguished in the logs of oil and gas wells drilled in the Highhat gas field, to the east and southeast of Willow West, but lack of significant drilling hampers their recognition at Willow West.

Only the Torrens Member and the basal part of the Falher Member remain in place as the caprock of Falls Mountain, the upper Falher and the entirety of the Notikewin Member having been removed by erosion. The erosional remnants of the Gates Formation are therefore inferred to be 50 to 60 metres thick within the area covered by **Map 2-3**.

The nature of the contact of the Gates over the underlying Moosebar Formation appears to be abrupt at local scale, but likely to be interfingering at the regional scale.

4.6.2 Moosebar Formation (map-units 4c, 4b, 3d, and 3c)

The Moosebar Formation, of early Albian age (Stott, 1968) forms the basal part of the Fort St John Group. At and near Willow West, the Moosebar Formation has a typical stratigraphic thickness of at least 165 metres and perhaps 205 to 240 metres (Wickenden and Shaw, 1943, page 4), although the latter figure likely indicates substantial structural thickening due to thrust-induced telescoping of the Moosebar rocks.

The Moosebar Formation comprises an overall coarsening-upward sequence, comprised of several lesser coarsening-upward cycles, of mudstone passing upward to sandy siltstone. A basal pebbly, locally-glauconitic gritstone occurs within the middle of the formation in some sections. Very thin (a few millimetres to a few decimetres) bands of tuff form conspicuous marker bands, generally concentrated within the basal 30 metres of the formation (Kilby, 1984a; 1985).

At Willow West, the Moosebar Formation is inferred to form bedrock along the block's southwestern, flanking the Gething coal-measures exposed within the western limb of the Pine River Anticlinorium (**Map 2-3**).

Regionally, deep exploratory drilling for natural gas targets allows the recognition of five lithological subdivisions (from top down, the Spieker and Cowmoose members, the Green Marker, and the Chamberlain and Bullmoose members) within the Moosebar Formation of the Willow West area. All five of these subdivisions are present and recognisable at Willow West, although one (the Green Marker, map-unit 4a) is consistently too thin to be mappable as anything other than a single line at the scale of **Map 2-3**.

4.6.2.1 Spieker Member (map-unit 4c)

The Spieker Member of the Moosebar Formation (Duff and Gilchrist, 1981), of early Albian age (Stott, 1968), comprises thinly-interbedded, coarsening-upward units of siltstone and very fine sandstone, within an overall coarsening-upward sequence.

Bioturbation is pervasive and intense within the Spieker Member, which is interpreted to have formed as shallow-water turbidites within a proximal shelf setting in advance of the northward-prograding Gates paleodelta. The undeformed thickness of the Spieker Member at Willow West is estimated to be 60 to 90 metres, possibly being locally thickened through thrust-induced structural telescoping.

The basal contact of the Spieker Member with the underlying Cowmoose Member is abrupt, generally drawn at the base of an upward decrease in natural gamma radiation, which appears to coincide with an upward increase in the silt content of the rocks, and a concomitant passage from dark greyish-black to medium grey rock colour. The immediate base of the Spieker Member is in some sections marked by one or two metres of distinctly-sandy siltstone.

4.6.2.2 Cowmoose Member (map-unit 4b)

At and near Willow West the Cowmoose Member of the Moosebar Formation, of early Albian age (Stott, 1968), consists of dark greyish-black to black mudstone with occasional thin but laterally-persistent (centimetre- to decimetre-scale) bands of tuff and infrequent bands of concretionary ironstone. Without recourse to cored sections or gamma-neutron logs, the Cowmoose Member is superficially similar (and therefore difficult to distinguish in isolated exposures) from the basal part of the older Bullmoose Member.

The undeformed thickness of the Cowmoose Member is 80 to 100 metres, possibly locally thickened to over 200 metres by thrust-induced structural telescoping (Cathyl-Huhn, 2015a; 2015b). The basal contact of the Cowmoose Member with the underlying Green Marker (an informal lithostratigraphic unit previously designated as the 'Bluesky-S unit' by Kilby, 1984b) is abrupt, being readily recognised as a downward decrease of gamma-log counts, and the downward appearance of distinctively-greenish glauconitic sediments.

4.6.2.3 Green Marker (map-unit 4a)

The basal contact of the Moosebar Formation with the underlying Chamberlain Member of the Gething Formation is marked by the Green Marker (Cathyl-Huhn and Avery, 2014c), a thin but laterally-persistent zone of erosive-based, pebbly, intensely-bioturbated, commonly-glauconitic sandstone, siltstone and mudstone. The Green Marker is generally a few decimetres to a metre thick. Owing to its minimal thickness, the Green Marker is depicted as a single line upon **Map 2-3**.

Although the lithology of the Green Marker is superficially similar to that of the older Bluesky Formation, these two glauconite-bearing zones are stratigraphically distinct, both in space and in time (Kilby, 1984b; Legun, 1990). Kilby's (*op. cit.*) 'Bluesky-S unit' corresponds to the beds currently mapped as the Green Marker, whereas his older and stratigraphically-lower 'Bluesky-N' unit corresponds to beds here mapped as the Bluesky Formation.

The basal contact of the Green Marker with the underlying Chamberlain Member, or with the Bullmoose Member where the Chamberlain is absent, is characteristically abrupt and likely to at least locally be erosional.

4.6.2.4 Chamberlain Member (map-unit 3d)

At Willow West, the Chamberlain Member of the Moosebar Formation is a geophysically-distinctive (moderately-low gamma-log responses) unit within the Moosebar, comprising a few (4 to perhaps 8) metres of rocks with a geophysical-log signature consistent with the regionally-known Chamberlain lithologies of interbedded sandstone and siltstone.

In contrast with the Chamberlain sections drilled in the Sukunka area (35 kilometres to the southwest of Willow West), no coal has been found within the Chamberlain Member at Willow West. Regionally, the Chamberlain Member is well-established as thinning to the east and northeast; it is locally altogether absent within oil and gas wells drilled at Highhat Mountain (a few tens of kilometres east of Willow West), and in those wells the Cowmoose mudstones appear to directly overlie the Bullmoose siltstones.

The Chamberlain Member is not known to contain diagnostic fossils; it has therefore been assigned an Early Albian age by Gibson (1992) on the basis of fossils found within the overlying Cowmoose Member of the Moosebar Formation.

The basal contact of the Chamberlain Member with the underlying Bullmoose Member is gradational by interbedding, being drawn at the base of the Chamberlain's sandstone. The Chamberlain-Bullmoose contact possibly rises stratigraphically, to the north and east, but available drilling does not suffice to confirm nor contradict this supposition.

4.6.2.5 Bullmoose Member (map-unit 3c)

The Bullmoose Member comprises about 120 metres of thinly-interbedded, recessive-weathering mudstone, siltstone and minor sandstone of turbiditic aspect, forming several fining-upward sequences within an overall coarsening-upward sequence.

The geophysical log response of the Bullmoose Member is very distinct, as compared with the overlying Chamberlain Member and the underlying Bluesky Member; Bullmoose rocks have characteristically-higher natural-gamma log responses.

The Bullmoose Member is inferred to form extensive areas of bedrock along the northeastern and southwestern margins of the Willow West block, and the Bullmoose is also inferred to be preserved within the core of a tight syncline along the block's northeastern side (**Map 2-3**).

The Bullmoose Member does not contain any coal, other than isolated coalified logs and coarse, poorly-preserved 'plant trash', likely of drifted origin. The Bullmoose does, however, contain abundant molluscan fossils, including *Pecten (Entolium)* cf. *irenense* McLearn (Gibson, 1992) and *Yoldia kissoumi* (Duff and Gilchrist, 1981), which, although not age-diagnostic, are locally-characteristic of the unit.

The Bullmoose Member likely corresponds with the 'Lower Silty Member' of the Moosebar Formation, as originally suggested by Duff and Gilchrist (1981), within those areas (for example, the deep subsurface under Highhat Mountain, southeast of the Willow West block) where the overlying Chamberlain Member is absent.

Geophysical logs of the Bullmoose Member show a characteristic high-gamma response at two horizons situated a few tens of metres above the Bullmoose/Bluesky contact. These gamma ‘spikes’ are interpreted to be thin bands of tuff, each of them one to two decimetres thick, with the lower of the two bands being more persistent. These bands provide a regionally-extensive geophysical marker throughout the Falling Creek region (Kilby, 1984a).

The basal contact of the Bullmoose Member with the underlying Bluesky Formation is drawn at the top of the underlying glauconitic sandy mudstone. In geophysical logs, the Bullmoose/Bluesky contact is readily recognised as a rapid downward change in log response to higher resistivity response, lower natural-gamma counts, and higher API neutron counts. This downward change is interpreted to correspond with a rapid downward passage from fine-grained mudstone of the basal Bullmoose, to the sandy mudstone and sandstone of the uppermost Bluesky.

The Bullmoose Member is of late Early Albian age (Gibson, 1992). The original stratigraphic thickness of the Bullmoose is approximately 100 metres at Willow West, although thicker sections (likely structurally-thickened by thrust-induced telescoping of the strata) are known. Similar anomalous thickening was previous noted from the Highhat Mountain area, where the Bullmoose Member was found to be 189 and 237 metres thick, respectively, in natural-gas wells b-91-L and a-23-D (Cathyl-Huhn, 2015b).

4.6.3 Bluesky Formation (map-unit 3b)

The Bluesky Formation is a transitional unit between marine and non-marine facies. Accordingly, there has been considerable debate within the geological literature -- cogently summarised by Stott (1968), and further discussed by Kilby (1984b) and Legun (1990) -- as to the Bluesky's stratigraphic affinities and proper ranking. In the present report, the Bluesky is considered to constitute a formation in its own right, bounded above by the Moosebar Formation, and beneath by the Gething Formation, following earlier workers (*cf.* Legun, 1990 and James, 1998). Further to the south within the Mink-Brazion coalfield, the Bluesky is considered to be a member within the Gething Formation (Cathyl-Huhn, 2015a; Cathyl-Huhn and Avery, 2014a; 2014b)

The Bluesky Formation generally consists of coarsening-upward cycles of interbedded mudstone, siltstone, and sandstone. The top of the Bluesky is characteristically marked by a glauconitic horizon. The glauconitic zone, where observed in the nearby Mink Creek property, is 40 to 57 centimetres thick (Sultan and Cathyl-Huhn, 2014), comprising abundant fine-grained, green glauconite within sandy mudstone and argillaceous, locally-pebbly, sandstone. The base of the Bluesky is marked by a distinctive erosive-based chert- and quartz-pebble conglomerate up to a metre thick, grading to argillaceous sandstone with few randomly-distributed chert and quartz pebbles.

The erosive-based Bluesky sediments likely represent the initial transgressive deposits of an early tongue of the Clearwater Sea, which shortly after deposition of the Bluesky had transgressed to a southerly limit several hundred kilometres southeast of the Willow Creek area (Gibson, 1992).

The Bluesky Formation, as-drilled at and near Willow West, is 4 to 16 metres thick (the latter thickness having been drilled within the CML Boulder c-03-F coalbed gas well (**Table A-4**), situated 0.5 kilometres west of the Willow West block's western boundary). The age of the Bluesky is not directly known, but inferred to be late Early Albian on the basis of the ages of its bounding strata.

4.7 Bullhead Group (map-units 3a and 2)

Both formations of the Bullhead Group -- the younger Gething and the older Cadomin -- are present at Willow West, with the Gething containing all of the block's known potentially-mineable coal beds.

4.7.1 Gething Formation (map-unit 3a)

The Gething Formation, of Hauterivian to late Early Albian age (Gibson, 1992), comprises thin to thick interbeds of siltstone, sandstone, mudstone and coal, with lesser amounts of gritstone, pebble-conglomerate, ironstone and tuff.

The Gething Formation originated as a complex of non-marine to shallow-marine sedimentary deposits, laid down by meandering and braided streams and rivers within a widely-extensive belt of coastal deltas and an intervening marine-influenced bay, of which the basal delta (the coal-bearing Gaylard paleodelta) extended throughout the Mink-Brazion coalfield, and the Willow Creek / Falling Creek area in general, including the Willow West block. At the latitude of Willow West, the overlying delta (the younger Chamberlain paleodelta) is presumed to have been only represented by a thin, non-coal-bearing, fringe of sandy/silty delta-front to prodeltaic deposits (Gibson, 1992).

The Gething Formation forms the top of the Bullhead Group (Stott, 1968, as used in the present report), and of the Crassier Group (*sensu* Hughes, 1964, as previously observed in the Mink Creek coal property by Sultan and Cathyl-Huhn, 2014). At Willow West, the Gething Formation's original thickness was at least 260 metres, and possibly 360 metres. In contrast, within the nearby Highhat gasfield (15 kilometres to the southeast of Willow West), complete sections of the Gething Formation are 475 to 720 metres thick, although some of that thickness is made up by marginal-marine deposits which are considered to be homotaxial with the basal part of the Moosebar Formation as found at Willow West.

During historic (pre-2011) as well as current (years-2011 and 2012) drilling within the Willow West block, nearly every coal-exploration borehole has intersected some section of the Gething Formation, but the thickness of the formation can only be indirectly estimated from this work, owing to lack of drilling into the underlying Cadomin Formation, as well as the block's pervasive structural complexity.

The basal contact of the Gething Formation with the underlying Cadomin Formation is inferred to be abrupt to possibly erosional at the local scale (Cant, 1996) and interfingering at the regional scale (Stott, 1968; Gibson, 1992), drawn at the top of a bed of coarse-grained, often gritty and occasionally pebbly sandstone which may laterally grade into more typical pebble-conglomerate or multi-storey sandstone characteristic of the underlying sub-Gething beds.

Only one member (the Gaylard Member) is recognised within the Gething Formation at Willow West, the overlying rocks being here assigned to the Moosebar Formation.

4.7.1.1 Internal subdivisions of the Gaylard Member

The Gaylard Member may be conveniently divided into five informal subdivisions, on the basis of characteristic lithologies (chiefly changes in sand-shale ratio, with alternations of sandier and shalier sub-units), anchored by the presence of thick and laterally-extensive coal zones which likely formed atop regionally-extensive interfluves. The divisions of the Gaylard are numbered in upward succession from Division 1 at the base of the Gaylard, to Division 5 at the top of the Gaylard. Drilling has established that the thickest, and possibly more laterally-extensive, coals occur within the middle portion (Division 3) of the Gaylard Member.

Table 4-1 (given above) summarises the subdivisions of the Gaylard Member. Major coal zones and other lithologies used as division markers are:

- No.4 coal zone, marking the base of Division 5;
- No.6 coal zone, marking the base of Division 4;
- No.8 coal zone, marking the base of Division 3;
- Heterolithic, mainly silty, strata forming Division 2; and
- Dominantly-sandy strata, comprising Division 1.

4.7.1.2 Sedimentological and cyclothemic details

The Gaylard Member is interpreted to consist predominantly of non-marine sedimentary rocks within the Willow West block, although the presence of at least one coal zone with slightly-elevated sulphur content (within the adjoining Willow South block) suggests that some marine influence may have occurred. The coal zone in question, No.8, lies within the basal half of the Gaylard Member.

The Gaylard Member consists principally of many vertically-stacked, locally erosive-based, fining-upward bedsets, such as are typical of fluvial and deltaic depositional settings.

A typical cyclic succession of Gaylard sediments commences with basal sandstone (rarely basal gritstone or pebble-conglomerate), passing upward through coarse- to fine-grained sandstone, siltstone, variably-carbonaceous mudstone, rooty seatearth mudstone and coal. Most, but not all, Gaylard cycles are capped by coal beds, although many of these coals are too thin, or too dirty, to be considered mineable. Coals frequently contain partings of siltstone or variably-carbonaceous mudstone, tuff (the 'tonstein' bands of Kilby, 1984a and 1985) and rarely of ironstone. The coals split and coalesce laterally, likely in interaction to avulsive events within river distributaries, and concomitant crevasse-splay sedimentation atop the coeval coal-forming wetlands (Banerjee and others, 1996).

Gamma-log response of the Gaylard sandstones (within and between these cycles) are 'ragged' in detail, occasionally capped by an upward-increasing 'bell-shaped' log response. In contrast, the siliceous sandstones and conglomerates within the underlying Cadomin Formation display distinctly 'blockier' responses than those of the Gaylard sandstones.

4.7.1.3 Speculations as to the thickness of the Gaylard Member

The thickness of the Gaylard Member is not directly known at Willow West, owing to the lack of completely-drilled sections, and the pervasive presence of incompetent structures comprising small- and large-scale thrust-faults (and some folds) within the coal-measures. From incomplete, but apparently minimally-disturbed, sections the Gaylard is established to be at least 260 metres thick at Willow West, and possibly up to 360 metres thick. Yet-greater thickness has not yet been ruled-out by ongoing structural and stratigraphic studies; still, the Gaylard Member's development at Willow West appears to be thinner than the 460 to 485 metres calculated for the Highhat River area (Cathyl-Huhn, 2015a).

4.7.2 Cadomin Formation (map-unit 2)

The Cadomin Formation immediately underlies the Gething Formation, forming the basal part of the Bullhead Group (Stott, 1968). As such, the Cadomin Formation includes strata which may alternatively be assigned to the now-deprecated Dresser Formation of the Crassier Group *sensu* Hughes (1964).

Regionally, the Cadomin Formation comprises one or more thick beds of coarse-grained, gritty to pebbly sandstone and pebble-conglomerate (McLean, 1977) with occasional lenses of siltstone and pebbly gritstone, and rare thin lenses of coal, several tens of metres thick overall.

The Cadomin Formation may be distinguished from the sandier parts of the Gaylard Member, upon the bases of the Cadomin Formation’s greater lateral continuity, the Cadomin's distinctly-'blocky' gamma-log response, and the frequent (but not universal, *cf.* Cant and Abrahamson, 1996) presence of an intervening zone of fine-grained coal-measures strata.

Again regionally, the base of the Cadomin marks a northeastward-deepening angular unconformity, cutting down into successively-older rocks of the Minnes Group (Stott, 1973).

Locally, it remains uncertain whether the Cadomin Formation has been reached by any of the historic or current boreholes at Willow West. By comparison with nearby properties, the Cadomin's basal contact with the underlying Bickford Formation of the Minnes Group is presumed to be erosional, with considerable local scour into the older sediments. The thickness of the Cadomin Formation at Willow West is unknown, on account of lack of deep drilling.

4.8 Minnes Group (map-unit 1)

The Minnes Group comprises 1000 to 1200 metres of clastic sedimentary rocks of latest Jurassic and earliest Cretaceous age, forming a poorly-exposed deltaic/shelfal/basinal complex which is overlain by the Bullhead Group. Four formations are locally recognised within the Minnes Group. From top down, they are the Bickford (equivalent to most of the now-deprecated Brenot Formation of Hughes, 1964), the Monach, the Beattie Peaks, and the Monteith formations (Stott, 1981; 1998). Coal is known to at least locally occur in all four of the Minnes Group's formations (Chowdry, 1980), but only the Bickford Formation is inferred to occur at reasonable depths within the Willow West block, and therefore to be a credible (albeit thus-far apparently-untested) target for coal exploration.

5 Coal

As discussed above in **Section 4**, the Gething Formation contains numerous coal beds, some of which are sufficiently thick and apparently laterally-continuous to constitute reasonable exploratory and mining targets, within the Willow West portion of the Willow Creek coal lease. All of the known Gething coals occur within that formation's Gaylard Member.

5.1 Regional correlations of major Gaylard coals

Regional correlations of Gaylard coals are here proposed, although not examined in detail:

- No.4 zone at Willow West may be correlative with the Brenda Seam at Hasler Creek, F zone at Mink Creek, Seam C60 at Burnt River, and the Lower Gething B zone at Sukunka Colliery;
- No.6 zone at Willow West may be correlative with the Upper Seam at Burnt River; and
- No.7 zone at Willow West may be correlative with the Lower Seam at Burnt River.

Coals of the Gaylard Member at Willow West, and their enclosing sedimentary rocks, were deposited during Hauterivian to late Early Albian time, between 112 and 133 million years ago, on the basis of regional plant-fossil and foraminiferal zonations, as presented by Gibson (1992).

5.1.1 Local naming scheme for Gaylard coals

Table 5-1 depicts the overall correlation scheme for coal zones, coal beds, and lesser subdivisions of coal beds, at Willow West. Coal zones are numbered downwards from No.1, near the top of the Gaylard Member, to No.12, postulated to lie close to the base of the Gaylard (or even, conceivably, within the older Bickford Formation although that supposition is not yet established). Each coal zone contains at least one major coal bed, and numerous subordinate and associated 'splits', 'stringers' and 'stringer plies'. Designations of the various major and minor coal beds have evolved with time from McKechnie's (1955) original concept of a series of numbered coal beds, into a more complex scheme of subordinate relationships. A system of split numbering was established by James (1998), who assigned odd terminal digits to subordinate coals lying above a major coal bed, and even terminal digits to those lying below a major coal bed.

5.1.2 Caveat concerning coal bed designations

The system of coal-bed designation presented within **Table 5-1** is not intended to imply that major ('00' terminal-digit) coal beds become completely split into subordinate beds. Furthermore, not all stringers necessarily originate as laterally-continuous extensions of major coal beds. Considerable work likely remains to fully-establish splitting and coalescent relationships.

5.2 Coals intersected by current boreholes at Willow West

Table A-2 (presented within **Appendix A**) presents information concerning coal intersections within all the year-2011 boreholes. Interpretative results of year-2012 boreholes have not yet been located, and therefore **Table A-3** (likewise in **Appendix A**) only presents details of formation contacts within the overlying cover rocks as intersected by those boreholes.

Table 5-1: Stratigraphic hierarchy of coal beds at Willow West

Formation	Member	Division	Coal Zone	Coal Bed	Split	Stringer	Stringer Ply
Gething	Gaylard	Division 5	**Bird**				
			No.1			***190***	
						170	
						150	
						130	
						110	
				100			
			No.2		***201***		
				200			
					202		
			No.3			***330***	
						310	
				300			
						320	
						340	
						350	
			No.4			***450***	
						430	
						410	
				400			
					402		
						420	
						440	
						460	
							483
							481
						480	
							482
		Division 4	**A**				***A71***
						A7	
							A72
						A5	
						A3	
							A32
							A34
				M1			
				M2			
							M22
					A11		
				A1			
					A12		
				A0			
					A02		
			No.5				531
						530	
							532
						510	
					501		
				500			
					502		
						520	
							541
						540	
						560	

Table 5-1: Stratigraphic hierarchy of coal beds at Willow West (concluded)

Formation	Member	Division	Coal Zone	Coal Bed	Split	Stringer	Stringer Ply
Gething	Gaylard	Division 4	**No.6**			***630***	
						610	
					601		
				600			
					602		
							641
						640	
							642
						660	
							662
						680	
		Division 3	**No.7**			770	
						750	
						730	
						710	
				700			
					702		
							721
						720	
							722
						740	
						760	
			No.8	800			
					802		
						820	
						840	
						880	
		Division 2	**No.9**			***910***	
				900			
						920	
						940	
		Division 1	**No.10**			***1010***	
				1000			
						1020	
			No.11			***1110***	
				1100			
							1121
						1120	
							1122
						1140	
			No.12			***1210***	
				1200			
						1220	

Note: table compiled by C.G. Cathyl-Huhn from Willow South deposit-modelling files. Drilling of coal zones No.9 through No.12 is sparse. Assignment of coal zones 11 and 12 to the Gething Formation is speculative, and merits further critical consideration. Coal beds shewn ***thus*** *(bold-italic) have not yet been recognised by means of detailed correlation; such zones are, however, known to be present at Willow South and their local presence at Willow West is therefore plausible although as-yet not established.*

Most of the coal intersections listed in **Table A-2** have been given identifying codes, such as '610', 'M3', or 'A3'. These codes have been assigned in aid of generating digital deposit models, subject to explicit hierarchical rules denoting their 'parent-child' relationships as the various coal zones and coal beds are interpreted to split and possibly rejoin laterally.

Certain of the coal intersections listed in **Table A-2** are denoted simply as 'Coal'; this notation signifies that they have not been assigned an identifying code within the correlation scheme. Also listed in **Table A-2** are faults (mostly as-interpreted from preliminary correlation of geophysical log responses -- it should not be presumed that all faults have been found), and the drilled extent of Drift cover above bedrock.

6 Coal quality

Owing to current drilling having been solely by non-coring methods, no current coal-quality data are known to be available. Very limited historic data are available.

6.1 Note concerning historic coal-quality data

One historic borehole, WRH97096C, was cored. Although data concerning this borehole are not available in non-confidential (thus public-facing) historic coal-assessment reports, core descriptions and analytical results for this borehole have been relocated within exploratory files obtained in the course of Walter Energy's merger with Western Coal.

Analysis of a composite clean-coal sample from this borehole indicted non-agglomerating (and hence non-coking) character of that coal, but such a single control-point cannot be held to represent a viable determination of the coal-quality characteristics of the Gaylard coals at Willow West.

7 Coal-resource estimation

Exploratory drilling is now sufficiently close-spaced to allow for coal-resource estimation to Canadian geometric standards (Hughes and others, 1989) within the northeastern half of the Willow West block, although with the caveat that coal-quality information is still essentially lacking.

A modelling-exercise was commenced following the completion of the year-2011 drilling programme, and the input data files from that work have been used to construct **Table A-2** (as given in **Appendix A**), as concerns drilled intersections of correlatable coal beds. Results of the year-2011 modelling have not yet been located within Walter Energy's Canadian technical files, and it may be that the modelling was not completed, as no input data files have been found concerning the year-2012 drilling. Furthermore, no results of coal-resource calculations have been found; it is therefore presumed that such an exercise has not yet been undertaken.

Recorrelation of the year-2011, year-2012, and historic boreholes is now underway, but no decision has yet been made concerning a renewed effort to construct a geological deposit model for the Willow West block.

8 Reclamation

Drilling at Willow West in years-2011 and 2012 required the construction or reoccupation of 53 drill sites, mostly situated along a combination of pre-existing and newly-built exploration trails. Some sites were accessed directly from existing high-grade roads, while others were reached via re-activated seismic lines, logging trails, and spur-roads. As per usual practice, the drill sites were cleared of equipment, supplies and trash prior to removal of the drilling rig, and appropriate revegetation seed mix was applied to the sites. The extent of reclamation of access trails is unknown, although some natural revegetation is considered likely to have taken place since the cessation of the year-2012 drilling programme.

9 Statement of costs

‘Current work’ at Willow West, for purposes of the present report, comprises exploratory work done in years-2011 and 2012. Work consisted mainly of drilling, by means of rotary (non-coring) methods. All of the boreholes were logged by means of downhole geophysical surveys (as discussed in **Appendix A** of this report). No analytical work is known to have been done in either year, as solely non-coring methods were used in drilling.

Owing to near-complete turnover of technical and operational staff, and the closure of Walter Energy's Canadian regional corporate office in Vancouver, British Columbia, detailed cost data have not been found for the current work. Costs given below in **Table 9-1** (given on the following page) are therefore estimated, based upon provincial average unit-costs on a per-metre basis relative to the overall total depth of drilling and geophysical surveying. Drilling and geophysical depths have been compiled from a collection of individual records, aggregated as hole-by-hole running totals.

Overall cost of current work is estimated to have been $2,542,545.55.

Table 9-1: Estimated exploratory cost breakdown by activity and year within Willow West block

Year	Rotary Drilling		Core Drilling		Geophysical Logging		Lab Analysis		Road work		Personnel		Yearly Cost Totals
	metres	Cost ($201.53/m)	metres	Cost ($210.34/m)	metres	Cost ($17.56/m)	metres	Cost ($79.63/m)	metres	Cost ($23.30/m)	metres	Cost ($20.49/m)	
2011	7013.66	$1,413,462.90	0	$ nil	6723.28	$118,060.80	0	$ nil	7013.66	$163,418.28	7013.66	$143,709.89	$1,838,651.87
2012	2679.19	$539,937.16	0	$ nil	2655.74	$46,634.79	0	$ nil	2679.19	$62,425.13	2679.19	$54,896.60	$703,893.68
Totals	9692.85	$1,953,400.06	0	$ nil	9379.02	$164,695.59	0	$ nil	9692.85	$225,843.41	9692.85	$198,606.50	$2,542,545.55

Notes: unit costs are on per-metre drilled length basis, derived from provincial average unit-costs, vide Bouchard (2011) report on behalf of Natural Resources Canada. Geophysical log metreage is slightly lower than drilled metreage, as the boreholes could not be logged to their total depths. Roadwork cost is derived from overall length of drilling, not scaled length of access trails. No cored drilling is known to have been done, and therefore analytical costs are considered to be nil in both years.

10 References

The following reference materials were used in the compilation of this report, with citations given at relevant points within the report's text. All coal-assessment reports here cited are available in digital versions via the British Columbia Geological Survey Branch's webspace, with the exception that year-2014 and year-2015 reports are still confidential at the time of this writing, with expected public release in 2017 and 2018.

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11 Conclusions

Coal occurrences, of potentially-workable thickness, occur within the Willow West block of the Willow Creek coal property. These coals are contained within the Gaylard Member of the Lower Cretaceous (Hauterivian to Early Albian) Gething Formation. The Gaylard coal-measures have a stratigraphic thickness of at least 260 metres, possibly 360 metres or more. Numerous coal zones, each containing one or more major coal beds, are present within the Gaylard Member. Coal beds split and coalesce laterally, complicating their correlation and tracing throughout the Willow West block.

Rocks at Willow West have been dislocated by several northeast-verging thrust faults, likely accompanied by incompetent mesoscale folds, within an overall monoclinal structural style consisted with lying within the southwestern trailing edge of the Pine River Anticlinorium. Structural geology of the Willow West block has fully worked-out in detail, although sufficient drilling likely exists to allow such studies to be conducted at a reasonable level of confidence, in support of coal-resource estimation.

In all, at 35 historic boreholes, totalling at least 1210.32 metres' length, have been drilled during years-1975 through 1997 within the Willow West block of the Willow Creek coal lease. An additional 53 current boreholes (here-reported for the first time), with overall length of 9692.85 metres, were drilled on the property in years-2011 and 2012. Overall drilling totals to date are 88 boreholes and 10,903.17 metres. This total does not include drilling (at locations not yet confirmed by site surveys, and for which logs are as-yet unavailable) of boreholes by the British Columbia Department of Mines in years-1946 through 1951.

Drilling at Willow West is regarded as sufficient to support the determination of coal-resources to current Canadian geometric standards (Hughes and others, 1989), following further study of coal-zone correlations and structural features, with the caveat that scarcity of coal-quality data precludes determination of the relative proportions of coking-coal, PCI coal, and thermal-coal within the deposit. Although a deposit-modelling exercise was commenced in year-2011, neither associated reports nor a coal-resource estimate have been thus-far found within accessible technical records.

Estimated current exploratory costs to date, covering year-2011 and 2012 activities, are $2,542,545.55. The Willow West block is regarded as being a property of merit, although requiring further study of coal quality, owing to lack of available site-specific coal-quality data.

12 Statements of qualifications

I, Preetpal Singh M.A.Sc., do hereby certify that:

a) I am currently employed on a full-time basis by Walter Canadian Coal Partnership, a subsidiary of Walter Energy, in their Northeast British Columbia office in Tumbler Ridge, British Columbia.

b) This certificate applies to the current report, titled *Coal Assessment Report for the Willow Creek coal lease -- Volume 2: Willow West area*, dated May 27, 2015.

c) I am a member of the IEEE Computer Society since 2006.

d) I am in the process of applying for registration with the Association of Professional Engineers and Geoscientists of British Columbia.

e) I received my Bachelor of Science in Computer Science from Laurentian University in 2008, and my Master's of Applied Science in Mineral Resource Engineering, also from Laurentian University, in 2012.

f) I have worked as a data analyst for Walter Canadian Coal Partnership since July of 2013.

g) I am a contributing author of this report, titled *Coal Assessment Report for the Willow Creek coal lease -- Volume 2: Willow West area*, dated May 27, 2015, concerning the Willow West block of the Willow Creek coal property.

I, Laura Rose LeMay B.Sc. B.Ed., do hereby certify that:

a) I was employed on a full-time basis by (and currently on maternity leave from) Walter Canadian Coal Partnership, a subsidiary of Walter Energy, in their Northeast British Columbia office in Chetwynd, British Columbia.

b) This certificate applies to the current report, titled *Coal Assessment Report for the Willow Creek coal lease -- Volume 2: Willow West area*, dated May 27, 2015.

c) I am in the process of applying for registration with the Association of Professional Engineers and Geoscientists of British Columbia.

d) I received my Bachelor of Science from Saint Mary's University in Halifax in 2006.

e) I have worked in the coal industry for 3 years and 8 months.

f) I have been pit geologist for the Brazion group of mines since March 2012.

g) I am a contributing author of this report, titled *Coal Assessment Report for the Willow Creek coal lease -- Volume 2: Willow West area*, dated May 27, 2015, concerning the Willow West block of the Willow Creek coal property.

I, C.G. Cathyl-Huhn P.Geo.(BC) Lic.Geol.(WA) RMSME, do hereby certify that:

a) I am currently employed on a full-time basis by Walter Canadian Coal Partnership, a subsidiary of Walter Energy, in their Northeast British Columbia office in Tumbler Ridge, British Columbia.

b) This certificate applies to the current report, titled *Coal Assessment Report for the Willow Creek coal lease -- Volume 2: Willow West area*, dated May 27, 2015.

c) I am a member (Professional Geoscientist, Licence No.20550) of the Association of Professional Engineers and Geoscientists of British Columbia, licensed as a geologist (Licence No.2089) in Washington State, and a founding Registered Member of the Society for Mining, Metallurgy and Exploration (SME, Member No.518350). I have worked as a colliery geologist in several countries for 37 years since my graduation from university.

d) I certify that by reason of my education, affiliation with professional associations, and past relevant work experience, having written numerous published and private reports and technical papers concerning coalfield geology, coal-mining geology and coal-resource estimation, that I am qualified as a Qualified Person as defined by Canadian *National Instrument 43-101* and a Competent Person as defined by the Australian *JORC Code*.

e) My most recent visit to the Willow West block of the Willow Creek coal property was in the summer of 1981.

f) I am principal author of this report, titled *Coal Assessment Report for the Willow Creek coal lease -- Volume 2: Willow West area*, dated May 27, 2015, concerning the Willow West block of the Willow Creek coal property.

g) As of the date of the writing of this report, I am not independent of Willow Creek Coal Partnership or Pine Valley Coal Ltd., pursuant to the tests in Section 1.4 of *National Instrument 43-101*.

"original signed and sealed by"

Dated this 27th day of May, 2015. C.G. Cathyl-Huhn P.Geo. Lic.Geol. RMSME

Appendix A: Geophysical logs and borehole statistics

Geophysical logging and the pertinent statistics of the current (years-2011 and 2012) boreholes are summarised in **Table A-1**. (commencing on the following page). Copies of the geophysical logs are submitted as digital files on a CD (optically-readable compact disk) accompanying this report, in LAS, TIF, and/or PDF formats.

LAS and TIF are the primary digital formats within which geophysical logs were provided by borehole-logging service companies; PDF is a secondary format, derived from scanning of hard-copy logs in those fewer cases in which digital logs have not been found within Walter Energy's files.

Geophysical logs are obtained by lowering a self-contained cylindrical sonde to the bottom of a borehole (or as close to the bottom as is safely practicable, given borehole wall stability conditions), and then drawing the sonde upward by means of a cable which contains power and data-transfer conductors. Depth reference on each log is based upon readings of a depth transponder connected to the geophysical logging system's drawworks. A very small amount of cable stretch may occur, depending upon the weight and diameter of each sonde; this accounts for slight variations in reported depths of log measurements as compared from one log suite to another.

Ordinarily, geophysical logs are run within boreholes once the drilling rods have been withdrawn. This practice allows for measurement of borehole diameter with a caliper instrument, and further allows for the effective collection of properly-calibrated log measurements. In some occasions, logs have been run within the drill rods, owing to concerns regarding borehole stability; these logs may or may not be subsequently be re-run with the rods withdrawn, again depending upon borehole conditions.

Positional and elevation data for boreholes are given in metres. Depths given on all geophysical logs are also given in metres, below the datum points mentioned in the headers of each log. Downhole depths reached by individual logging suites will vary, according to the length of each sonde, and also according to the source/detector geometry (and hence the measurement reference point) of each sonde. Geophysical log depth is therefore generally slightly less than driller's reported depth of each hole.

Downhole geophysical logs run in current boreholes: **Table A-1**

Borehole	UTM (NAD83, Zone 10)		Collar Elevation	Total depth	Azi-muth	Dip	Year Drilled	Drilling method	LAS file available	Density/ Gamma/ Caliper/ Resistivity	Gamma/ Density/ Slim Tool	Gamma/ Neutron	Dip-meter	Deviation
	Easting	Northing												
WW11-01	546365.952	6161722.371	697.185	201.16	40.5	-60.7	2011	Rotary	Y	200.03	195.1	200.09		199.9
WW11-02	546406.605	6161761.412	715.554	158.49	37	-60.2	2011	Rotary	Y	154.05		154.15		153.96
WW11-03	548561.197	6160762.58	994.19	176.78	185.8	-89.7	2011	Rotary	Y	116.45	116.45	95.68		95.48
WW11-04	548533.66	6160732.899	1008.665	128.01	224	-59.5	2011	Rotary	Y	126.62		126.84		126.64
WW11-05	548407.441	6160597.847	1020.353	210.31	44.2	-59.8	2011	Rotary	Y	207.26		207.34		207.14
WW11-06	548332.334	6160517.534	1017.777	170.68	43.1	-55.8	2011	Rotary	Y	118.39		118.54		118.34
WW11-07	548282.75	6160462.327	1020.729	201.16	42.4	-56.5	2011	Rotary	Y	150.07		150.07		149.82
WW11-08	548226.069	6160403.826	1015.658	201.16	43	-54.5	2011	Rotary	Y	200.07		200.19		200
WW11-09	548151.062	6160326.155	1004.671	234.69	37.7	-58.5	2011	Rotary	Y	233.31		233.27		233.08
WW11-10	547739.764	6160622.542	990.968	213.36	63	-60.1	2011	Rotary	Y	212.01		212.05		211.86
WW11-11	548042.821	6160950.038	996.584	201.16	44.8	-61.3	2011	Rotary	Y	199.08		199.12		198.92
WW11-12	547911.9	6160800.445	992.101	158.49	36.8	-61	2011	Rotary	Y	157.13		157.19		157
WW11-13	547878.78	6160769.632	994.304	170.69	42.8	-59.2	2011	Rotary	Y	168.83		169.11		168.92
WW11-14	547907.514	6160873.179	984.89	195.07	41	-60.3	2011	Rotary	Y	186.64		191.82		191.68
WW11-15	547814.454	6160701.205	988.961	179.83	56.5	-59.7	2011	Rotary	Y	178.4		178.5		178.3
WW11-16	548122.581	6161037.644	1008.018	152.4	266.3	-89.3	2011	Rotary	Y	142.46		142.56		142.36
WW11-17	547533.122	6161126.178	952.259	146.3	272.8	-58.4	2011	Rotary	Y	141.69		141.67		141.46
WW11-18	547469.354	6161059.4	933.153	146.3	50.3	-57	2011	Rotary	Y	141.69		141.67		141.46
WW11-19	547440.214	6161027.833	925.319	112.77	42	-57.7	2011	Rotary	Y	111.02		111.26		111.06
WW11-20	547364.258	6160952.992	937.953	202.38	40.2	-57.1	2011	Rotary	Y	201.17		201.01		200.82
WW11-21	547302.569	6160882.24	954.949	249.93	33	-52.5	2011	Rotary	Y	248.03		248.15		247.96
WW11-22	547214.703	6161200.673	925.137	109.72	41	-59.8	2011	Rotary	Y	108.36		108.44		108.24
WW11-23	547326.531	6161338.256	895.815	228.6	40	-59.4	2011	Rotary	Y	220.19		226.78		226.58
WW11-24	546313.049	6161642.846	689.311	222.5	44	-56.7	2011	Rotary	Y	221.73		221.77		221.58
WW11-25	546437.708	6161793.24	727.372	124.96	43.4	-57	2011	Rotary	Y	124.16		124.2		124
WW11-26	547249.677	6161256.573	914.357	161.54	35.1	-58.5	2011	Rotary	Y	159.04		159.88		159.68
WW11-27	547055.842	6161262.29	893.69	161.54	45.5	-57.9	2011	Rotary	Y	157.63		158.11		157.92
WW11-28	546997.946	6161221.718	876.801	185.92	38.6	-58.2	2011	Rotary	Y	182.54	180.25	182.84		182.64

Downhole geophysical logs run in current boreholes: **Table A-1** (concluded)

Borehole	UTM (NAD83, Zone 10)		Collar Elevation	Total depth	Azi-muth	Dip	Year Drilled	Drilling method	LAS file available	Density/ Gamma/ Caliper/ Resistivity	Gamma/ Density/ Slim Tool	Gamma/ Neutron	Dip-meter	Deviation
WW11-29	546928.79	6161147.986	868.733	228.6	39.2	-57.4	2011	Rotary	Y	227.84		227.93		227.74
WW11-30	546809.481	6161478.166	848.239	185.92	38.5	-55.9	2011	Rotary	Y	148.41		185.35		185.16
WW11-31	546667.938	6161266.709	792.946	207.32	45.8	-58.3	2011	Rotary	Y	205.91		205.95		205.76
WW11-32	546735.662	6161358.973	801.019	225.61	39	-58.8	2011	Rotary	Y	224.71		224.61		224.42
WW11-33	546777.888	6161418.456	831.288	192	44.8	-56.2	2011	Rotary	Y	188.27		188.03		187
WW11-34	546520.752	6161629.15	775.137	207.3	43.7	-59	2011	Rotary	Y	206.46		206.4		205
WW11-35	546461.661	6161571.036	745.518	152.44	44.9	-59.3	2011	Rotary		150.5		150.58		150.38
WW11-36	546377.205	6161510.132	719.609	192.02	39.6	-59.2	2011	Rotary	Y	188.04		187.96		187.76
WW11-37	546291.428	6161420.099	697.106	216.46	33.4	-55.5	2011	Rotary		215		214.98		214
WW11-38	546247.839	6162295.292	671.332	200.09	41.3	-58.1	2011	Rotary	Y	200.09		200.07		199.88
WW12-01	546864.588	6161070.137	875.322	158.54	43.7	-57.6	2012	Rotary		158.36		158.54		158.34
WW12-02	546779.06	6161042.761	870.191	207.26	44.9	-58.6	2012	Rotary		206.3		206.36		206.16
WW12-03	546736.724	6160924.317	889.597	210.31	35.1	-58	2012	Rotary		205.63		206.2		206
WW12-04	546672.855	6160849.808	855.402	182.88	42.3	-60.6	2012	Rotary		176.33		177.01		176.82
WW12-05	548596.338	6160812.157	987.929	164.59	40.6	-61.6	2012	Rotary		163.98		163.98		163.78
WW12-06	548738.467	6160957.051	935.57	173.73	38.7	-60.4	2012	Rotary		172.67		172.63		172.44
WW12-07	548612.09	6161177.84	901.842	146.3	40.3	-60.5	2012	Rotary		146.13		146.19		146
WW12-08	548588.62	6160055.123	1062.933	175.26	44.9	-58.8	2012	Rotary		171.98		172.08		171.88
WW12-09	548511.149	6159983.617	1070.934	219.68	39.2	-57	2012	Rotary		219.68		217.3		179.8
WW12-10	548687.446	6160150.647	1035.78	246.88	45.4	-57.9	2012	Rotary		243.64				243.96
WW12-11	548653.577	6160120.66	1049.451	174.65	43	-60	2012	Rotary		173.51				
WW12-12	548207.531	6161112.061	1002.802	150.32	0	-90	2012	Rotary		150.32				
WW12-13	548297.417	6161226.982	995.724	150.28	0	-90	2012	Rotary		150.28				
WW12-14	548487.445	6161051.058	1011.514	143.86	223	-75	2012	Rotary		143.86				
WW12-15	548393.448	6160942.41	1024.11	174.65	47.5	-88.3	2012	Rotary		173.07		172.81		172.62

Table A-2: Lithological interpretation of year-2011 boreholes

Borehole	Metres			Bed	Interpreter's comments	Interpretation		Change notes
	From	To	Thickness			Picked	Checked	
WW11-01	0.00	9.14	9.14	Drift		LRL	IM	Changed overburden thickness
WW11-01	10.61	12.14	1.53	400		LRL	IM	
WW11-01	12.90	13.10	0.20	402		IM		
WW11-01	20.62	20.72	0.10	440		LRL	IM	
WW11-01	25.00	25.10	0.10	460		IM		
WW11-01	45.63	45.78	0.15	483		LRL	IM	483
WW11-01	54.76	54.86	0.10	481		LRL	IM	481
WW11-01	56.74	57.03	0.29	480		LRL	IM	480
WW11-01	63.44	63.68	0.24	Coal	A3?	LRL	IM	Coal
WW11-01	66.49	67.36	0.87	A7	A1?	LRL	IM	A7
WW11-01	86.98	87.34	0.36	A5		LRL	IM	A5
WW11-01	90.34	90.46	0.12	A3		LRL	IM	A3
WW11-01	91.80	92.00	0.20	A3		IM		A3
WW11-01	102.62	103.00	0.38	Coal		LRL	IM	Coal
WW11-01	108.02	108.27	0.25	A32		LRL	IM	A32
WW11-01	115.76	116.26	0.50	Coal		LRL	IM	Coal
WW11-01	147.12	147.68	0.56	A1		LRL	IM	A1
WW11-01	147.68	148.09	0.41			LRL	IM	Parting
WW11-01	148.09	148.41	0.32	A1		LRL	IM	A1 - Use full seam when entering into GEMS
WW11-01	148.41	149.56	1.15			LRL	IM	Parting
WW11-01	149.56	150.68	1.12	A0		LRL	IM	A0
WW11-01	150.68	152.57	1.89			LRL	IM	Parting
WW11-01	152.57	153.17	0.60	500		LRL	IM	500
WW11-01	153.17	153.71	0.54			LRL	IM	Parting

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

	Metres					Interpretation		
Borehole	From	To	Thickness	Bed	Interpreter's comments	Picked	Checked	Change notes
WW11-01	153.71	154.22	0.51	500		LRL	IM	500 - Use full seam when entering into GEMS
WW11-01	161.73	162.61	0.88	600		LRL	IM	600 (?)
WW11-01	170.79	171.11	0.32	660		LRL	IM	660 (?)
WW11-01	171.11	171.92	0.81			LRL	IM	Parting
WW11-01	171.92	172.02	0.10	660		LRL	IM	660 (?)
WW11-01	172.02	173.67	1.65			LRL	IM	Parting
WW11-01	173.67	174.00	0.33	680		LRL	IM	680
WW11-01	182.51	182.87	0.36	770		LRL	IM	770 (?)
WW11-02	0.00	3.05	3.05	Drift		LRL	IM	Changed Drift thickness
WW11-02	5.78	5.88	0.10	460		LRL	IM	460
WW11-02	26.02	26.19	0.17	483		LRL	IM	483
WW11-02	34.38	34.52	0.14	481		LRL	IM	481
WW11-02	36.05	36.40	0.35	480		LRL	IM	480
WW11-02	45.28	45.50	0.22	A7		LRL	IM	A7
WW11-02	45.67	45.77	0.10			LRL	IM	Parting
WW11-02	45.86	46.19	0.33	A7		LRL	IM	A7 - Use full seam when entering into GEMS
WW11-02	65.72	66.23	0.51	A5		LRL	IM	A5 - Changed picks from 65.88 - 65.98 to 65.72 - 66.23
WW11-02	70.78	70.91	0.13	A3	A2?	IM		A3
WW11-02	80.94	81.45	0.51	Coal		LRL	IM	Coal
WW11-02	85.18	85.39	0.21	A32		LRL	IM	A32
WW11-02	93.00	93.40	0.40	Coal		LRL	IM	Coal

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

	Metres					Interpretation		
Borehole	From	To	Thickness	Bed	Interpreter's comments	Picked	Checked	Change notes
WW11-02	122.89	124.19	1.30	A1		LRL	IM	A1
WW11-02	124.19	125.63	1.44			LRL	IM	Parting
WW11-02	125.63	126.83	1.20	A0		LRL	IM	A0
WW11-02	126.83	128.60	1.77			LRL	IM	Parting
WW11-02	128.60	129.18	0.58	500		LRL	IM	500
WW11-02	129.18	129.81	0.63			LRL	IM	Parting
WW11-02	129.81	130.34	0.53	500		LRL	IM	500
WW11-02	138.43	139.22	0.79	600		LRL	IM	600 (?)
WW11-02	147.67	148.04	0.37	660		LRL	IM	660 (?)
WW11-02	148.59	148.78	0.19	660		LRL	IM	660 (?)
WW11-02	150.26	150.81	0.55	680		LRL	IM	680 (?)
WW11-03	0.00	1.60	1.60	Drift		LRL	IM/GCH	IM Note: Changed Drift thickness. *GCH adds: further correction*
WW11-03	4.10	4.24	0.14	*Fault*		LRL	IM	IM Note: Hole cave? *GCH adds: Fault, possible; note breakout*
WW11-03	8.00	8.10	0.10	*Fault*		LRL	IM/GCH	IM Note: Hole cave? *GCH adds: Fault, possible; note breakout*
WW11-03	27.40	27.50	0.10	*Fault*		LRL	IM/GCH	IM Note: Hole cave? *GCH adds: Fault, possible; note breakout*
WW11-03	27.70	28.00	0.30	Coal		IM		
WW11-03	37.42	37.54	0.12	Coal		LRL	IM	
WW11-03	38.36	38.51	0.15	Coal		LRL	IM	
WW11-03	40.61	41.38	0.77	Coal		LRL	IM	A5? No
WW11-03	51.52	51.82	0.30	Coal		LRL	IM	A3? No

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

	Metres					Interpretation		
Borehole	From	To	Thickness	Bed	Interpreter's comments	Picked	Checked	Change notes
WW11-03	52.24	52.79	0.55	Coal		LRL	IM	A3? No
WW11-03	58.80	58.90	0.10	A1		LRL	IM	
WW11-03	58.90	60.93	2.03			LRL	IM	Parting
WW11-03	60.93	61.26	0.33	A0		LRL	IM	
WW11-03	61.26	62.41	1.15			LRL	IM	Parting
WW11-03	62.46	62.56	0.10	A0		LRL	IM	AO split
WW11-03	70.95	80.20	0.25	*Fault*	500 faulted away?	LRL	IM/GCH	*GCH adds: Fault, probable; note breakout*
WW11-03	88.68	88.82	0.14	510	or 500?	LRL	IM	
WW11-03	88.82	90.56	1.74			LRL	IM	Parting
WW11-03	90.56	92.00	1.44	500		LRL	IM	500?
WW11-03	92.80	92.90	0.10	Fault		IM		
WW11-03	95.56	97.41	1.85	500	600R or 700?	LRL	IM	500 repeat
WW11-03	97.41	98.84	1.43			LRL	IM	Parting
WW11-03	98.84	99.48	0.64	540		LRL	IM	630?
WW11-03	99.48	100.93	1.45			LRL	IM	Parting
WW11-03	100.93	101.09	0.16	560		LRL	IM	610?
WW11-03	103.21	105.64	2.43	600	600R or 700?	LRL	IM	
WW11-03	105.64	106.19	0.55			LRL	IM	Parting
WW11-03	106.19	107.12	0.93	600		LRL	IM	
WW11-03	107.12	107.52	0.40			LRL	IM	Parting
WW11-03	107.52	107.91	0.39	600		LRL	IM	
WW11-03	107.91	109.19	1.28			LRL	IM	Parting
WW11-03	109.19	109.24	0.05	602		LRL	IM	620? No

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

	Metres					Interpretation		
Borehole	From	To	Thickness	Bed	Interpreter's comments	Picked	Checked	Change notes
WW11-03	119.21	119.32	0.11	640		IM		
WW11-03	145.83	146.04	0.21	Coal		IM		
WW11-03	146.55	146.68	0.13	Coal		IM		
WW11-04	0.00	1.85	1.85	Drift		LRL	IM	
WW11-04	5.11	5.68	0.57	Coal	Coal above A1	LRL	IM	
WW11-04	12.61	12.79	0.18	Coal		LRL	IM	A3? No
WW11-04	12.79	14.81	2.02			LRL	IM	Parting
WW11-04	13.81	14.33	0.52	Coal		LRL	IM	A3? No
WW11-04	17.80	17.90	0.10			LRL	IM	Maybe not faulted?
WW11-04	22.13	22.23	0.10	A1		LRL	IM	
WW11-04	22.23	24.36	2.13			LRL	IM	Parting
WW11-04	24.36	24.61	0.25	A0		LRL	IM	A2 below this? No
WW11-04	53.99	55.94	1.95	500		LRL	IM	
WW11-04	59.23	59.93	0.70	540		LRL	IM	
WW11-04	61.37	61.67	0.30	560		LRL	IM	
WW11-04	63.19	64.27	1.08	600		LRL	IM	
WW11-04	65.08	65.22	0.14	602		LRL	IM	
WW11-04	74.74	75.06	0.32	660	Coal under 600 in WW11-11	LRL	IM	
WW11-04	75.82	76.08	0.26	660		LRL	IM	
WW11-04	77.28	77.88	0.60	662		LRL	IM	660? No
WW11-04	87.70	87.80	0.10	Fault		IM		
WW11-04	88.32	88.83	0.51	500	700 sequence?	LRL	IM	repeat
WW11-04	88.83	91.89	3.06			LRL	IM	Parting

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

Borehole	Metres				Interpreter's comments	Interpretation		Change notes
	From	To	Thickness	Bed		Picked	Checked	
WW11-04	91.89	93.11	1.22	540		LRL	IM	repeat
WW11-04	94.73	98.04	3.31	600		LRL	IM	repeat
WW11-04	98.04	99.50	1.46			LRL	IM	Parting
WW11-04	99.50	99.60	0.10	602		LRL	IM	repeat
WW11-04	104.50	104.60	0.10	660		LRL	IM	repeat
WW11-05	0.00	2.90	2.90	Drift		LRL	IM/GCH	Changed Drift thickness. *GCH adds: Drift thickness okay*
WW11-05	15.32	15.52	0.20	Coal		LRL	IM	*Probably need to change WW11-05 to match WW11-06 and 07!
WW11-05	20.22	20.32	0.10	A1		LRL	IM	
WW11-05	24.13	24.28	0.15	A0		LRL	IM	
WW11-05	35.28	36.59	1.31	500		LRL	IM	
WW11-05	41.28	41.43	0.15	540		LRL	IM	
WW11-05	46.77	47.28	0.51	560		LRL	IM	
WW11-05	52.47	52.83	0.36	600		LRL	IM	
WW11-05	52.83	53.54	0.71			LRL	IM	Parting
WW11-05	53.54	54.51	0.97	600		LRL	IM	
WW11-05	59.85	59.95	0.10	640		LRL	IM	
WW11-05	62.80	62.90	0.10	660		LRL	IM	
WW11-05	93.95	94.19	0.24	750		LRL	IM	
WW11-05	148.72	149.06	0.34	700		GCH		*Very dirty coal*
WW11-05	149.06	149.70	0.64	700		LRL	IM/GCH	Must later verify if this is 7 seam. *GCH adds: reinterpreted; clean coal*
WW11-05	149.70	150.00	0.30	700		GCH		*Dirty coal; possibly few centimetres of coaly rock at top*
WW11-05	150.00	150.30	0.30			GCH		*Sharp passage downward into coaly rock*
WW11-05	150.30	150.55	0.25			GCH		*Carbonaceous rock; floor*

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

	Metres					Interpretation		
Borehole	From	To	Thickness	Bed	Interpreter's comments	Picked	Checked	Change notes
WW11-05	163.75	163.85	0.10	720		LRL	IM	
WW11-05	171.19	171.29	0.10	740		LRL	IM	
WW11-05	174.89	175.35	0.46	760		LRL	IM	
WW11-06	0.00	4.24	4.24	Drift	Deepened	LRL	IM	
WW11-06	11.87	11.97	0.10	480		LRL	IM	
WW11-06	30.07	31.36	1.29	A7		LRL	IM	100? No
WW11-06	35.96	36.74	0.78	A5		LRL	IM	120? No
WW11-06	44.24	44.37	0.13	A3		LRL	IM	140? No
WW11-06	45.42	45.57	0.15	A3		LRL	IM	140? No
WW11-06	70.42	70.52	0.10	Coal	Coal above A1	LRL	IM	
WW11-06	73.98	74.12	0.14	A1		LRL	IM	210? No
WW11-06	74.12	77.56	3.44			LRL	IM	Parting
WW11-06	77.56	77.71	0.15	A0		LRL	IM	200? No
WW11-06	88.84	90.18	1.34	500		LRL	IM	300? No
WW11-06	95.17	95.27	0.10	540		LRL	IM	
WW11-06	103.86	104.97	1.11	600		LRL	IM	400? No
WW11-06	148.24	148.34	0.10	770		LRL	IM	
WW11-06	152.52	152.76	0.24	750		LRL	IM	
WW11-07	0.00	7.42	7.42	Drift	Deepened	LRL	IM	
WW11-07	17.89	19.02	1.13	300		LRL	IM	

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

Borehole	Metres				Interpreter's comments	Interpretation		Change notes
	From	To	Thickness	Bed		Picked	Checked	
WW11-07	19.02	20.93	1.91	400		LRL	IM	
WW11-07	27.69	28.12	0.43	440		LRL	IM	
WW11-07	29.52	29.62	0.10	460		LRL	IM	
WW11-07	40.28	40.38	0.10	481		LRL	IM	
WW11-07	51.52	51.62	0.10	480		LRL	IM	
WW11-07	69.11	71.14	2.03	A7		LRL	IM	
WW11-07	76.20	77.31	1.11	A5		LRL	IM	
WW11-07	85.56	86.06	0.50	A3		LRL	IM	
WW11-07	87.18	87.37	0.19	A3		LRL	IM	
WW11-07	110.27	110.37	0.10	Coal	Coal above A1	LRL	IM	
WW11-07	115.71	115.98	0.27	A1		LRL	IM	
WW11-07	119.84	120.11	0.27	A01	A1R	LRL	IM	A0 split? Yes
WW11-07	120.11	121.61	1.50			LRL	IM	Parting
WW11-07	121.61	122.06	0.45	A0		LRL	IM	
WW11-07	135.87	137.49	1.62	500		LRL	IM	
WW11-07	143.81	143.91	0.10	540		LRL	IM	
WW11-07	153.11	153.87	0.76	600		LRL	IM	
WW11-07	159.79	160.38	0.59	640	770? 600 split?	LRL	IM	
WW11-08	0.00	6.10	6.10	Drift		LRL	IM	Changed Drift thickness
WW11-08	26.91	28.21	1.30	100		LRL	IM	
WW11-08	37.79	38.74	0.95	200		LRL	IM	

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

Borehole	Metres			Bed	Interpreter's comments	Interpretation		Change notes
	From	To	Thickness			Picked	Checked	
WW11-08	51.69	52.12	0.43	300		LRL	IM	
WW11-08	52.81	53.17	0.36	400		LRL	IM	
WW11-08	53.17	53.57	0.40			LRL	IM	
WW11-08	53.57	55.14	1.57	400		LRL	IM	
WW11-08	62.51	62.89	0.38	440		LRL	IM	
WW11-08	70.80	70.90	0.10	483		LRL	IM	
WW11-08	80.10	80.20	0.10	481		LRL	IM	
WW11-08	90.12	90.22	0.10	480		LRL	IM	
WW11-08	109.39	110.57	1.18	A7		LRL	IM	
WW11-08	116.61	117.57	0.96	A5		LRL	IM	
WW11-08	126.00	126.10	0.10	A3		LRL	IM	
WW11-08	126.95	127.21	0.26	A3		LRL	IM	
WW11-08	154.22	154.44	0.22	A1		LRL	IM	
WW11-08	157.47	157.63	0.16	A0		LRL	IM	A0?
WW11-08	168.99	170.21	1.22	500		LRL	IM	500?
WW11-08	176.27	176.37	0.10	540		LRL	IM	540?
WW11-08	186.82	188.62	1.80	600		LRL	IM	600?
WW11-08	196.18	196.88	0.70	640		LRL	IM	640? 770? Make consistent with WW11-07
WW11-09	0.00	23.15	23.15	Drift		LRL	IM/GCH	*GCH notes: revised Drift thickness*
WW11-09	23.15	28.00	4.85	*Bluesky?*	*Basal part only?*	GCH		
WW11-09	28.00	-----	-----	*Gaylard*	*Top of Division 5*	GCH		
WW11-09	37.43	37.68	0.25	150		LRL	IM	Too low for Bird? Bird picked higher in WW11-29
WW11-09	72.63	74.52	1.89	100		LRL	IM	
WW11-09	81.86	82.61	0.75	200		LRL	IM	

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

	Metres					Interpretation		
Borehole	From	To	Thickness	Bed	Interpreter's comments	Picked	Checked	Change notes
WW11-09	96.52	97.09	0.57	300		LRL	IM	
WW11-09	99.61	101.61	2.00	400		LRL	IM	
WW11-09	109.29	109.73	0.44	440		LRL	IM	
WW11-09	135.52	135.62	0.10	480		LRL	IM	
WW11-09	155.49	156.72	1.23	A7		LRL	IM	
WW11-09	164.23	165.44	1.21	A5		LRL	IM	
WW11-09	174.36	174.58	0.22	A3		LRL	IM	
WW11-09	175.11	175.26	0.15	A3		LRL	IM	
WW11-09	202.36	202.46	0.10	A1		LRL	IM	
WW11-09	206.02	206.22	0.20	A0		LRL	IM	
WW11-09	217.27	219.59	2.32	500		LRL	IM	Make the bottom seams consistent with holes 11-06, 11-07 and 11-08
WW11-09	225.22	225.32	0.10	540		LRL	IM	
WW11-10	0.00	5.65	5.65	Drift		LRL	IM/GCH	*GCH changed Drift thickness*
WW11-10	7.10	8.00	0.90	Coal		LRL	IM/GCH	*GCH changed coal thickness to match strong log response*
WW11-10	21.10	22.10	1.00	*Ash*	*Ash band (high gamma)*	GCH		*Possibly sheared or faulted from 21.40 to 22.10 m*
WW11-10	46.10	46.55	0.45	150	or Upper 1	LRL	IM	IM Notes: Too low for Bird? Bird picked higher in WW11-29. *GCH adds: sheared coaly rock; caliper log indicates partial breakout*
WW11-10	77.24	79.20	1.96	100		LRL	IM	
WW11-10	85.53	86.51	0.98	200		LRL	IM	
WW11-10	103.07	103.92	0.85	300		LRL	IM	
WW11-10	112.20	113.62	1.42	400		LRL	IM	
WW11-10	120.43	121.10	0.67	440		LRL	IM	

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

	Metres					Interpretation		
Borehole	From	To	Thickness	Bed	Interpreter's comments	Picked	Checked	Change notes
WW11-10	124.06	124.18	0.12	460		LRL	IM	
WW11-10	140.90	141.00	0.10	481		LRL	IM	
WW11-10	147.18	147.51	0.33	480		LRL	IM	
WW11-10	166.18	167.43	1.25	A7		LRL	IM	
WW11-10	172.11	173.33	1.22	A5		LRL	IM	
WW11-10	182.62	182.78	0.16	A3		LRL	IM	
WW11-10	183.88	184.21	0.33	A3		LRL	IM	
WW11-10	190.80	191.04	0.24	Coal		IM		High ash - typically HCC [coaly rock or dirty coal]
WW11-10	193.10	193.25	0.15	Coal		IM		High ash - typically HCC [coaly rock or dirty coal]
WW11-11	0.00	7.70	7.70	Drift		LRL	IM/GCH	*Changed Drift thickness*
WW11-11	14.71	14.89	0.18	540		LRL	IM	
WW11-11	25.30	25.50	0.20			GCH		*Coaly rock*
WW11-11	25.50	25.66	0.16			GCH		*Rock*
WW11-11	25.66	25.92	0.26			GCH		*Carbonaceous rock*
WW11-11	25.92	26.45	0.53	600		GCH		*Dirty coal; changed roof contact*
WW11-11	26.45	27.42	0.97	600		LRL	IM/GCH	*GCH notes: clean coal; recognised overlying dirty coal*
WW11-11	27.42	27.62	0.20					*Carbonaceous rock; immediate floor*
WW11-11	34.61	34.72	0.11	Coal		LRL	IM	
WW11-11	37.48	37.77	0.29	641		LRL	IM	
WW11-11	38.33	38.62	0.29	640		LRL	IM	
WW11-11	72.26	72.59	0.33	750		LRL	IM	
WW11-11	105.55	106.18	0.53	700		LRL	IM	IM notes: 7 Seam not as well developed in this area? *GCH notes: clean coal; changed roof contact; recognised basal dirty coal.*
WW11-11	106.18	106.60	0.42	700		GCH		*Dirty coal*

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

	Metres					Interpretation		
Borehole	From	To	Thickness	Bed	Interpreter's comments	Picked	Checked	Change notes
WW11-11	106.60	106.85	0.25			GCH		*Coaly rock; immediate floor*
WW11-11	134.71	134.81	0.10	Coal		LRL	IM	
WW11-11	149.42	149.76	0.34	800		LRL	IM	Below 7 sequence?
WW11-11	160.65	160.75	0.10	Coal		LRL	IM	
WW11-11	196.87	196.95	0.08	900		LRL	IM	Below 7 sequence?
WW11-12	0.00	8.20	8.20	Drift	Deepened	LRL	IM	Changed Drift thickness
WW11-12	9.18	9.32	0.14	Coal		IM		
WW11-12	10.62	10.73	0.11	483		LRL	IM	
WW11-12	23.20	23.40	0.20	481		LRL	IM	
WW11-12	28.72	29.02	0.30	480		LRL	IM	
WW11-12	48.32	49.87	1.55	A7		LRL	IM	
WW11-12	54.00	55.48	1.48	A5		LRL	IM	
WW11-12	65.06	65.29	0.23	A3		LRL	IM	
WW11-12	66.62	66.92	0.30	A3		LRL	IM	
WW11-12	74.72	74.82	0.10	A32		LRL	IM	
WW11-12	88.95	89.12	0.17	A11		LRL	IM	A11
WW11-12	90.19	91.02	0.83	A1		LRL	IM	
WW11-12	95.32	95.70	0.38	A0		LRL	IM	A0
WW11-12	98.78	100.32	1.54	500		LRL	IM	500?
WW11-12	110.95	111.05	0.10	540		LRL	IM	540?
WW11-12	123.92	126.04	2.12	600		LRL	IM	600?
WW11-12	135.31	135.86	0.55	641		LRL	IM	641?
WW11-12	136.42	136.83	0.41	640		LRL	IM	640?
WW11-12	143.52	143.71	0.19	660		IM		660?

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

	Metres					Interpretation		
Borehole	From	To	Thickness	Bed	Interpreter's comments	Picked	Checked	Change notes
WW11-13	0.00	9.14	9.14	Drift	No logging in casing	LRL	IM	Changed Drift thickness
WW11-13	10.62	13.26	2.64	400		LRL	IM	
WW11-13	20.52	21.18	0.66	440		LRL	IM	
WW11-13	24.73	24.82	0.09	460		LRL	IM	
WW11-13	31.90	32.00	0.10	483		LRL	IM	
WW11-13	44.69	44.80	0.11	481		LRL	IM	
WW11-13	50.35	50.60	0.25	480		LRL	IM	
WW11-13	70.33	71.58	1.25	A7		LRL	IM	
WW11-13	75.99	77.67	1.68	A5		LRL	IM	
WW11-13	86.60	86.80	0.20	A3		LRL	IM	
WW11-13	86.80	88.08	1.28			LRL	IM	Parting
WW11-13	88.08	88.39	0.31	A3		LRL	IM	
WW11-13	95.88	96.04	0.16	A32		LRL	IM	A32
WW11-13	113.68	114.62	0.94	A1		LRL	IM	
WW11-13	118.52	118.79	0.27	A0		LRL	IM	A0
WW11-13	121.80	123.39	1.59	500		LRL	IM	500?
WW11-13	134.25	134.35	0.10	540		LRL	IM	540?
WW11-13	147.22	149.32	2.10	600		LRL	IM	600?
WW11-13	159.40	159.76	0.36	640		LRL	IM	640?
WW11-14	0.00	17.55	17.55	Drift		LRL	IM/GCH	*GCH changed Drift thickness slightly*
WW11-14	18.60	20.07	1.47	A5		LRL	IM	No A7?
WW11-14	29.78	29.98	0.20	A3		LRL	IM	
WW11-14	31.46	31.79	0.33	A3		LRL	IM	

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

	Metres					Interpretation		
Borehole	From	To	Thickness	Bed	Interpreter's comments	Picked	Checked	Change notes
WW11-14	40.11	40.53	0.42	A32		LRL	IM	A32
WW11-14	54.56	55.18	0.62	A1		LRL	IM	
WW11-14	58.54	58.72	0.18	A0		LRL	IM	A0
WW11-14	61.74	63.32	1.58	500		LRL	IM	500
WW11-14	74.95	75.05	0.10	540		LRL	IM	540
WW11-14	86.66	88.98	2.32	600		LRL	IM	600
WW11-14	98.84	99.16	0.32	641		LRL	IM	641
WW11-14	99.16	99.78	0.62			LRL	IM	Parting
WW11-14	99.78	100.12	0.34	640		LRL	IM	640
WW11-14	100.12	100.73	0.61			LRL	IM	Parting
WW11-14	100.73	100.84	0.11	642		LRL	IM	642
WW11-14	105.25	105.35	0.10	660		IM		660
WW11-14	132.52	132.62	0.10	770		IM		770
WW11-14	137.12	137.46	0.34	750		LRL	IM	750
WW11-14	172.20	173.52	0.32	700		LRL	IM/GCH	700? Confirm this with other logs. *GCH adds: reinterpreted as thin clean coal above thicker dirty coal*
WW11-14	172.52	173.13	0.61	700		GCH		*Dirty coal*
WW11-14	173.13	173.32	0.19			GCH		*Gradational passage downward into coal rock; immediate floor*
WW11-15	0.00	9.14	9.14	Drift		LRL	IM	Changed Drift thickness
WW11-15	18.40	20.47	2.07	100		LRL	IM	
WW11-15	26.28	27.18	0.90	200		LRL	IM	
WW11-15	44.02	45.11	1.09	300		LRL	IM	
WW11-15	50.40	52.06	1.66	400		LRL	IM	
WW11-15	57.88	58.28	0.40	440		LRL	IM	

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

	Metres					Interpretation		
Borehole	From	To	Thickness	Bed	Interpreter's comments	Picked	Checked	Change notes
WW11-15	71.30	71.40	0.10	483		LRL	IM	
WW11-15	81.24	81.50	0.26	481		LRL	IM	
WW11-15	87.12	87.35	0.23	480		LRL	IM	
WW11-15	106.60	108.19	1.59	A7		LRL	IM	
WW11-15	112.13	113.43	1.30	A5		LRL	IM	
WW11-15	123.12	123.36	0.24	A3		LRL	IM	
WW11-15	124.60	125.19	0.59	A3		LRL	IM	
WW11-15	132.56	132.79	0.23	A32		LRL	IM	
WW11-15	154.21	154.93	0.72	A1		LRL	IM	
WW11-15	155.66	155.92	0.26	A1		LRL	IM	
WW11-15	158.72	158.80	0.08	A0		LRL	IM	A0
WW11-15	162.51	164.06	1.55	500		LRL	IM	500?
WW11-16	0.00	7.80	7.80	Drift		LRL	IM/GCH	*GCH changed Drift thickness*
WW11-16	29.29	29.42	0.13	770		IM		770
WW11-16	33.70	34.30	0.60	750		LRL	IM	750; *GCH changed thickness to match strong log response*
WW11-16	71.60	72.10	0.50	700		LRL	IM/GCH	700; *GCH adds: clean coal per log response; changed contacts*
WW11-16	72.10	72.60	0.50	700		LRL	IM/GCH	700; *GCH adds: dirty coal per log response; changed contacts*.
WW11-16	72.60	72.85	0.25			GCH		*Coaly rock per log response; forms immediate floor*
WW11-16	108.00	110.75	2.75			GCH		*Carbonaceous mudstone; almost coaly mudstone near base*
WW11-16	110.75	111.15	0.40	Coal	R600	LRL	IM/GCH	IM Notes: Coal. Don't think it's faulted, but near anticline. Lower part of log stretched out? *GCH adds: dirty coal; changed contacts to match log response.*
WW11-16	135.48	136.84	1.36	800		LRL	IM/GCH	800. *GCH adds: clean coal; amended thickness*
WW11-16	136.84	137.88	1.04			LRL	IM/GCH	Parting. *GCH amended thickness per strong log response*

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

Borehole	Metres			Bed	Interpreter's comments	Interpretation		Change notes
	From	To	Thickness			Picked	Checked	
WW11-16	138.20	138.39	0.19	802		GCH		802. *GCH adds: gradational passage downward into dirty coal*
WW11-16	138.20	138.39	0.19	802		GCH		802. *GCH adds: gradational passage downward into dirty coal*
WW11-16	138.39	138.66	0.27			GCH		*Gradational passage downward into coaly rock; immediate floor*
WW11-17	0.00	3.05	3.05	Drift		LRL	IM	Changed Drift thickness
WW11-17	14.26	15.36	1.10	A7		LRL	IM	
WW11-17	16.60	16.75	0.15	Fault		LRL	IM	Maybe a hole cave?
WW11-17	18.52	19.54	1.02	A7		LRL	IM	
WW11-17	21.46	22.00	0.54	A7		LRL	IM	
WW11-17	26.59	27.86	1.27	A5		LRL	IM	
WW11-17	36.47	36.70	0.23	A3		LRL	IM	
WW11-17	38.34	38.62	0.28	A3		LRL	IM	
WW11-17	46.00	46.40	0.40	A32		LRL	IM	
WW11-17	73.26	73.36	0.10	A1		LRL	IM	A1
WW11-17	74.62	75.83	1.21	A0		LRL	IM	A0
WW11-17	75.83	76.44	0.61			LRL	IM	Parting
WW11-17	76.44	76.89	0.45	A0		LRL	IM	A0
WW11-17	76.89	78.82	1.93			LRL	IM	Parting
WW11-17	78.82	80.57	1.75	500		LRL	IM	500
WW11-17	102.02	102.44	0.42	600		LRL	IM	600
WW11-17	102.44	102.82	0.38			LRL	IM	Parting
WW11-17	102.92	104.27	1.35	600		LRL	IM	600
WW11-17	115.36	115.88	0.52	641		LRL	IM	641
WW11-17	116.44	116.67	0.23	640		LRL	IM	640
WW11-17	121.36	121.50	0.14	660		IM		660

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

Borehole	Metres			Bed	Interpreter's comments	Interpretation		Change notes
	From	To	Thickness			Picked	Checked	
WW11-18	0.00	7.00	7.00	Drift		LRL	IM	
WW11-18	13.33	13.78	0.45	440		LRL	IM	
WW11-18	14.95	15.08	0.13	460		LRL	IM	
WW11-18	28.70	28.80	0.10	483		LRL	IM	Changed pick points (28.70 m instead of 38.70 m)
WW11-18	38.57	38.68	0.11	481		LRL	IM	
WW11-18	40.52	40.76	0.24	480		LRL	IM	
WW11-18	71.73	72.46	0.73	A5	No A7?	LRL	IM	A7 not present
WW11-18	79.40	79.64	0.24	A3		LRL	IM	
WW11-18	80.97	81.20	0.23	A3		LRL	IM	
WW11-18	87.85	88.10	0.25	A32		LRL	IM	
WW11-19	0.00	3.05	3.05	Drift		LRL	IM	Changed Drift thickness
WW11-19	17.81	18.84	1.03	300		LRL	IM	
WW11-19	30.13	31.07	0.94	400		LRL	IM	
WW11-19	37.16	37.61	0.45	440		LRL	IM	
WW11-19	39.75	39.85	0.10	460		LRL	IM	
WW11-19	50.90	51.00	0.10	483		LRL	IM	
WW11-19	62.40	62.50	0.10	481		LRL	IM	
WW11-19	91.00	92.07	1.07	A7	A7 splits	LRL	IM	
WW11-19	92.07	93.12	1.05			LRL	IM	Parting
WW11-19	93.12	93.57	0.45	A7		LRL	IM	

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

	Metres					Interpretation		
Borehole	From	To	Thickness	Bed	Interpreter's comments	Picked	Checked	Change notes
WW11-19	97.66	98.77	1.11	A5		LRL	IM	
WW11-19	105.52	105.78	0.26	A3		LRL	IM	
WW11-19	107.87	107.98	0.11	A3		LRL	IM	
WW11-20	0.00	19.95	19.95	Drift	Deepened	LRL	IM/GCH	*GCH notes: revised thickness of Drift*
WW11-20	19.95	24.65	4.70	Bullmoose		GCH		
WW11-20	24.65	30.70	6.05	Bluesky		GCH		*Characteristic low gamma response at top and base*
WW11-20	30.70	-----	-----	Gaylard	Top of Division 5	GCH		
WW11-20	47.76	48.07	0.31	150		LRL	IM	Too low for Bird? Bird picked higher in WW11-29
WW11-20	65.48	66.95	1.47	100		LRL	IM	
WW11-20	73.46	73.71	0.25	200		LRL	IM	
WW11-20	89.80	90.05	0.25	Cave		LRL	IM	Hole cave?
WW11-20	103.43	104.67	1.24	300		LRL	IM	
WW11-20	116.16	117.25	1.09	400		LRL	IM	
WW11-20	122.60	122.94	0.34	440		LRL	IM	
WW11-20	125.05	125.15	0.10	460		LRL	IM	
WW11-20	138.30	138.40	0.10	483		LRL	IM	
WW11-20	148.65	148.75	0.10	481		LRL	IM	
WW11-20	150.63	150.90	0.27	480		LRL	IM	
WW11-20	173.15	173.55	0.40	A7		LRL	IM	
WW11-20	173.91	174.50	0.59	A7		IM		
WW11-20	176.30	177.18	0.88	A7		LRL	IM	A7 Split
WW11-20	182.45	183.67	1.22	A5		LRL	IM	
WW11-20	191.65	191.87	0.22	A3		LRL	IM	

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

	Metres					Interpretation		
Borehole	From	To	Thickness	Bed	Interpreter's comments	Picked	Checked	Change notes
WW11-20	194.00	194.20	0.20	A3		LRL	IM	
WW11-20	198.50	198.82	0.32	A32		LRL	IM	
WW11-21	0.00	23.90	23.90	Drift		LRL	IM/GCH	*GCH notes: changed Drift thickness. Low-density zone near base of Drift may be peat layer within a buried soil zone; alternatively, may be weathered coal entrained within basal Drift*
WW11-21	23.90	50.60	26.70	*Bullmoose*		GCH		
WW11-21	50.60	51.20	0.60	*Bluesky*		GCH		*Characteristic low gamma response*
WW11-21	51.20	51.30	0.60	*Bluesky*		GCH		*Sheared coaly rock?*
WW11-21	51.30	51.60	0.30	*Fault*	*Fault, probable*	IM	GCH	*GCH: caliper log indicates breakout; repeats Bullmoose/Bluesky contact. IM had 51.09 to 51.32 as coal.*
WW11-21	51.60	71.30	19.70	*Bullmoose*		GCH		
WW11-21	71.30	75.75	4.45	*Bluesky*		GCH		*Characteristic low gamma response at top and base*
WW11-21	76.50	77.00	0.50			GCH		*Carbonaceous rock*
WW11-21	82.60	82.90	0.30			GCH		*Coaly rock*
WW11-21	88.20	88.70	0.50			GCH		*Coaly rock*
WW11-21	94.10	94.90	0.69	Coal		IM	GCH	*GCH notes: clean coal; changed thickness due to strong log response*
WW11-21	130.85	131.45	0.60	150		LRL	IM	IM notes: Too low for Bird? Bird picked higher in WW11-29. *GCH adds: dirty coal; changed thickness*
WW11-21	149.00	150.45	1.45	100		LRL	IM/GCH	*GCH notes: clean coal; changed roof contact*
WW11-21	150.45	150.75	0.30	100		GCH		*Dirty coal; changed floor contact*
WW11-21	157.80	158.10	0.30					*Coaly rock; immediate roof*
WW11-21	158.10	158.30	0.20	200		LRL	IM/GCH	*GCH notes: dirty coal*
WW11-21	158.30	158.50	0.20					*Coaly rock; immediate floor*
WW11-21	186.59	187.40	0.81	300		LRL	IM/GCH	*GCH notes: clean coal; noted underlying dirty coal*
WW11-21	187.40	187.75	0.35	300		GCH		*Dirty coal*

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

	Metres					Interpretation		
Borehole	From	To	Thickness	Bed	Interpreter's comments	Picked	Checked	Change notes
WW11-21	187.75	187.95	0.20	300		GCH		*Clean coal*
WW11-21	187.95	188.10	0.15	300		GCH		*Gradational passage downward into dirty coal*
WW11-21	198.35	199.55	1.20	400		LRL	IM/GCH	*GCH notes: clean coal; changed roof and floor contact; might have very thin partings or fusainous bands in middle*
WW11-21	203.55	203.85	0.30	440		LRL	IM/GCH	*GCH notes: dirty coal; changed roof and floor contact*
WW11-21	216.00	216.20	0.20			GCH		*Carbonaceous mudstone*
WW11-21	217.35	217.70	0.35			GCH		*Coaly mudstone; possibly thinner dirty coal*
WW11-21	227.05	227.30	0.25	481		LRL	IM/GCH	*GCH notes: coaly rock; possibly thinner dirty coal; changed contacts*
WW11-21	229.00	229.15	0.15			GCH		*Coaly rock; immediate roof*
WW11-21	229.15	229.30	0.15	480		LRL	IM/GCH	*GCH notes: dirty coal; changed contacts*
WW11-21	229.30	229.40	0.10			GCH		*Coaly rock: immediate floor*
WW11-21	229.80	230.00	0.20	*Ash*	*Ash band (high gamma)*	GCH		
WW11-22	0.00	3.05	3.05	Drift		LRL	IM	Changed Drift thickness
WW11-22	11.32	12.91	1.59	100		LRL	IM	
WW11-22	21.40	21.80	0.40	200		LRL	IM	
WW11-22	41.00	41.71	0.71	300		LRL	IM	
WW11-22	41.71	42.09	0.38			LRL	IM	Parting
WW11-22	42.09	42.34	0.25	300		LRL	IM	
WW11-22	57.92	59.16	1.24	400		LRL	IM	
WW11-22	65.72	65.94	0.22	440		LRL	IM	
WW11-22	66.70	66.84	0.14	460		LRL	IM	
WW11-22	82.54	82.68	0.14	483		LRL	IM	
WW11-22	89.93	90.10	0.17	481		LRL	IM	
WW11-22	91.48	91.75	0.27	480		LRL	IM	

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

Borehole	Metres			Bed	Interpreter's comments	Interpretation		Change notes
	From	To	Thickness			Picked	Checked	
WW11-23	0.00	50.20	50.20	Drift		LRL	IM	Added Drift thickness
WW11-23	50.34	50.44	0.10	A1		LRL	IM	A1
WW11-23	51.64	52.86	1.22	A0		LRL	IM	A0 (A1/A0 merged?)
WW11-23	54.41	54.51	0.10	A0		LRL	IM	A0
WW11-23	57.20	58.20	1.00	500		LRL	IM	500
WW11-23	77.31	78.62	1.31	600		LRL	IM	600
WW11-23	90.00	90.10	0.10	641		LRL	IM	641
WW11-23	91.95	92.05	0.10	640		LRL	IM	640
WW11-23	125.24	125.52	0.28	770		IM		770 (dirty)
WW11-23	129.56	129.84	0.28	750		LRL	IM	750
WW11-23	164.58	165.13	0.55	700		LRL	IM	700
WW11-23	165.85	165.95	0.10	702		LRL	IM	702
WW11-23	193.65	193.75	0.10	Coal	770? Need 7 Bed to confirm	LRL	IM	Coal
WW11-23	205.35	205.52	0.17	800	750?	LRL	IM	800
WW11-23	212.07	212.17	0.10	Coal	730?	LRL	IM	Coal (900?)
WW11-24	0.00	12.50	12.50	Drift		LRL	IM	
WW11-24	18.50	18.75	0.25	100		LRL	IM	
WW11-24	31.68	31.96	0.28	200		LRL	IM	
WW11-24	40.60	41.37	0.77	300		LRL	IM	
WW11-24	50.15	50.25	0.10	410		LRL	IM	
WW11-24	54.23	55.17	0.94	400		LRL	IM	
WW11-24	70.62	70.75	0.13	460		LRL	IM	
WW11-24	88.19	88.37	0.18	483		LRL	IM	483

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

	Metres					Interpretation		
Borehole	From	To	Thickness	Bed	Interpreter's comments	Picked	Checked	Change notes
WW11-24	99.14	99.23	0.09	481		LRL	IM	481
WW11-24	101.41	101.73	0.32	480		LRL	IM	480
WW11-24	108.35	108.81	0.46	Coal		IM		
WW11-24	112.25	112.52	0.27	A7		LRL	IM	A7
WW11-24	113.27	113.57	0.30	A7		LRL	IM	A7 - Consider one seam when entering into GEMS
WW11-24	130.81	131.33	0.52	A5		LRL	IM	A5
WW11-24	134.78	134.87	0.09	A3		LRL	IM	A3
WW11-24	134.87	135.75	0.88			LRL	IM	Parting
WW11-24	135.75	135.85	0.10	A3		LRL	IM	A3
WW11-24	149.18	149.70	0.52	Coal		LRL	IM	Coal
WW11-24	149.70	150.30	0.60			LRL	IM	Parting
WW11-24	150.30	150.49	0.19	Coal		LRL	IM	Coal
WW11-24	153.47	153.78	0.31	A32		LRL	IM	A32
WW11-24	161.46	161.65	0.19	Coal		LRL	IM	Coal
WW11-24	161.65	162.15	0.50			LRL	IM	Parting
WW11-24	162.15	162.86	0.71	Coal		LRL	IM	Coal - consider one seam when entering into GEMS
WW11-24	197.48	198.18	0.70	A1		LRL	IM	A1
WW11-24	198.18	198.55	0.37			LRL	IM	HCC [coaly rock or dirty coal] Parting
WW11-24	198.55	199.57	1.02	A0		LRL	IM	A0
WW11-24	199.57	202.92	3.35	A0		LRL	IM	A0
WW11-24	202.92	203.50	0.58			LRL	IM	Parting
WW11-24	203.50	204.92	1.42	500		LRL	IM	500 - Changed roof pick from 204.05 to 203.50
WW11-24	204.92	205.21	0.29			LRL	IM	Parting
WW11-24	205.21	206.10	0.89	500		LRL	IM	500

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

Borehole	Metres			Bed	Interpreter's comments	Interpretation		Change notes
	From	To	Thickness			Picked	Checked	
WW11-24	213.05	213.15	0.10	601		LRL	IM	601 (?)
WW11-24	214.00	215.03	1.03	600		LRL	IM	600 (?)
WW11-25	0.00	1.70	1.70	Drift		LRL	IM	
WW11-25	5.95	6.07	0.12	483		LRL	IM	483
WW11-25	13.65	13.93	0.28	481		LRL	IM	481
WW11-25	15.45	15.66	0.21	480		LRL	IM	480
WW11-25	20.05	20.15	0.10	Coal		LRL	IM	Coal
WW11-25	20.90	21.00	0.10	Coal		LRL	IM	Coal
WW11-25	23.37	24.17	0.80	A7		LRL	IM	A7
WW11-25	44.66	45.22	0.56	A5	A12?	LRL	IM	A5
WW11-25	45.22	50.45	5.23			LRL	IM	Interseam
WW11-25	50.45	50.65	0.20	A3		LRL	IM	A3
WW11-25	59.20	60.18	0.98	Coal		LRL	IM	Coal
WW11-25	64.82	64.97	0.15	A32		LRL	IM	A32
WW11-25	66.44	66.54	0.10	HCC		LRL	IM	HCC [coaly rock or dirty coal]
WW11-25	72.40	72.80	0.40	Coal		LRL	IM	Coal
WW11-25	98.72	99.32	0.60	A1		LRL	IM	A1
WW11-25	99.32	99.62	0.30			LRL	IM	Parting
WW11-25	99.62	100.05	0.43	A1		LRL	IM	A1
WW11-25	100.05	101.60	1.55			LRL	IM	Parting
WW11-25	101.60	103.68	2.08	A0		LRL	IM	A0
WW11-25	103.68	106.14	2.46			LRL	IM	Parting
WW11-25	106.14	106.68	0.54	500		LRL	IM	500

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

	Metres					Interpretation		
Borehole	From	To	Thickness	Bed	Interpreter's comments	Picked	Checked	Change notes
WW11-25	106.68	107.33	0.65			LRL	IM	Parting
WW11-25	107.33	107.90	0.57	500		LRL	IM	500
WW11-25	114.73	114.81	0.08	601		LRL	IM	601 (?)
WW11-25	115.68	116.56	0.88	600		LRL	IM	600 (?)
WW11-26	0.00	2.80	2.80	Drift		LRL	IM	
WW11-26	14.14	15.98	1.84	400		LRL	IM	
WW11-26	22.78	23.17	0.39	440		LRL	IM	
WW11-26	24.07	24.17	0.10	460		LRL	IM	
WW11-26	39.57	39.65	0.08	483		LRL	IM	
WW11-26	46.56	46.66	0.10	481		LRL	IM	
WW11-26	48.00	48.27	0.27	480		LRL	IM	
WW11-26	82.00	82.62	0.62	A7		LRL	IM	
WW11-26	83.00	83.60	0.60	A7		LRL	IM	
WW11-26	86.80	87.05	0.25	A7		LRL	IM	
WW11-26	95.52	97.15	1.63	A5		LRL	IM	
WW11-26	108.08	108.47	0.39	A3		LRL	IM	Changed floor pick point 109.47 m to 108.47 m
WW11-26	117.28	117.71	0.43	A32		LRL	IM	
WW11-26	131.67	131.78	0.11	A1		LRL	IM	A1
WW11-26	132.27	133.35	1.08	A1		LRL	IM	A1
WW11-26	133.06	134.38	1.32	A0		LRL	IM	A0
WW11-26	134.38	135.00	0.62			LRL	IM	Parting
WW11-26	135.00	135.62	0.62	A0		LRL	IM	A0
WW11-26	135.62	136.62	1.00			LRL	IM	Parting

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

Borehole	Metres			Bed	Interpreter's comments	Interpretation		Change notes
	From	To	Thickness			Picked	Checked	
WW11-26	136.42	137.35	0.93	A0		LRL	IM	A0
WW11-26	140.13	141.76	1.63	500		LRL	IM	500
WW11-27	0.00	3.05	3.05	Drift		LRL	IM	Changed Drift thickness
WW11-27	23.66	25.26	1.60	100		LRL	IM	
WW11-27	34.66	34.80	0.14	200		LRL	IM	
WW11-27	50.36	51.82	1.46	300		LRL	IM	
WW11-27	67.46	69.35	1.89	400		LRL	IM	
WW11-27	76.89	77.35	0.46	440		LRL	IM	
WW11-27	78.38	78.48	0.10	460		LRL	IM	
WW11-27	93.77	93.92	0.15	483		LRL	IM	
WW11-27	104.66	104.79	0.13	481		LRL	IM	
WW11-27	106.52	106.89	0.37	480		LRL	IM	
WW11-27	135.05	135.15	0.10	Coal		LRL	IM	
WW11-27	136.60	137.39	0.79	A7		LRL	IM	
WW11-27	137.39	137.85	0.46			LRL	IM	Parting
WW11-27	137.85	138.04	0.19	A7		LRL	IM	
WW11-27	143.47	143.64	0.17	Coal		LRL	IM	
WW11-27	150.50	151.96	1.46	A5		LRL	IM	
WW11-27	154.41	154.72	0.31	Coal		LRL	IM	Coal above A3
WW11-27	156.48	156.70	0.22	A3		LRL	IM	
WW11-28	0.00	5.10	5.10	Drift		LRL	IM	
WW11-28	5.10	9.70	4.60	*Bluesky*	*Basal part only*	GCH		*Characteristic low gamma log response at base*
WW11-28	9.70	-----	-----	*Gaylard*	*Top of Division 5*	GCH		

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

Borehole	Metres			Bed	Interpreter's comments	Interpretation		Change notes
	From	To	Thickness			Picked	Checked	
WW11-28	16.10	16.15	0.05	Coal		IM		Coal - Typically HCC [coaly rock or dirty coal] or carbonaceous claystone
WW11-28	23.52	23.62	0.10	Coal	?	LRL	IM	Coal - Too low for Bird? Bird picked higher in WW11-29
WW11-28	34.26	34.47	0.21	150	?	LRL	IM	150
WW11-28	35.95	36.05	0.10	130	?	LRL	IM	130
WW11-28	61.44	62.50	1.06	100		LRL	IM	
WW11-28	72.04	72.57	0.53	200		LRL	IM	Changed roof pick point from 72.40 to 72.04
WW11-28	84.23	85.05	0.82	300		LRL	IM	
WW11-28	85.05	85.40	0.35			LRL	IM	Parting
WW11-28	85.40	85.60	0.20	300		LRL	IM	
WW11-28	98.46	98.56	0.10	410		LRL	IM	
WW11-28	99.40	101.06	1.66	400		LRL	IM	
WW11-28	107.83	108.12	0.29	440		LRL	IM	
WW11-28	109.08	109.13	0.05	460		LRL	IM	
WW11-28	145.90	146.00	0.10	Coal	Missing 480 sequence	LRL	IM	480 sequence not present. Missing ~10 m strata compared to WW11-29(??)
WW11-28	147.65	148.26	0.61	A7		LRL	IM	
WW11-28	148.26	148.65	0.39			LRL	IM	Parting
WW11-28	148.65	149.31	0.66	A7		LRL	IM	
WW11-28	167.78	169.20	1.42	A5		LRL	IM	
WW11-28	171.30	171.40	0.10	Coal		LRL	IM	Coal above A3
WW11-28	173.60	174.84	1.24	A3		LRL	IM	
WW11-28	178.67	179.00	0.33	A3		LRL	IM	
WW11-29	0.00	31.20	31.20	Drift		LRL	IM/GCH	*GCH: changed Drift thickness.*
WW11-29	31.20	39.80	8.60	*Bullmoose*		GCH		
WW11-29	39.80	43.80	4.00	*Bluesky*		GCH		*Characteristic double low-gamma response at top and base*

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

Borehole	Metres			Bed	Interpreter's comments	Interpretation		Change notes
	From	To	Thickness			Picked	Checked	
WW11-29	43.80	-----	-----	*Gaylard*		GCH		*Top of Division 5 of Gaylard*
WW11-29	51.55	51.90	0.35	*Bird?*		LRL	IM/GCH	*GCH: dirty coal; possibly Bird Seam*
WW11-29	63.05	63.90	0.85	170	170?	LRL	IM	IM Notes: 170 as correlated with WW11-31. *GCH adds: changed thickness*
WW11-29	88.09	88.36	0.27	Coal		LRL	IM	Coal - Typically HCC [coaly rock or dirty coal]
WW11-29	89.92	90.03	0.11	Coal		LRL	IM	Coal - Typically HCC [coaly rock or dirty coal]
WW11-29	98.43	98.75	0.32	150		LRL	IM	150
WW11-29	100.25	100.35	0.10	130		LRL	IM	130
WW11-29	118.36	119.47	1.11	100		LRL	IM	
WW11-29	132.71	133.18	0.47	200		LRL	IM	
WW11-29	145.08	146.42	1.34	300		LRL	IM	
WW11-29	159.73	160.85	1.12	400		LRL	IM	
WW11-29	166.67	166.87	0.20	440		LRL	IM	
WW11-29	168.26	168.36	0.10	460		LRL	IM	
WW11-29	182.28	182.57	0.29	483		LRL	IM	
WW11-29	194.65	194.76	0.11	481		LRL	IM	
WW11-29	196.12	196.50	0.38	480		LRL	IM	
WW11-29	218.16	218.62	0.46	A7		LRL	IM	
WW11-29	218.62	218.91	0.29			LRL	IM	Parting
WW11-29	218.91	219.40	0.49	A7		LRL	IM	
WW11-30	0.00	1.45	1.45	Drift		LRL	IM	
WW11-30	10.14	10.35	0.21	110		IM	IM	
WW11-30	11.48	11.82	0.34	100		LRL	IM	

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

Borehole	Metres			Bed	Interpreter's comments	Interpretation		Change notes
	From	To	Thickness			Picked	Checked	
WW11-30	24.56	25.22	0.66	200		LRL	IM	
WW11-30	34.92	35.57	0.65	300		LRL	IM	
WW11-30	48.71	49.67	0.96	400		LRL	IM	
WW11-30	55.72	55.86	0.14	440		LRL	IM	
WW11-30	57.22	57.75	0.53	460		LRL	IM	
WW11-30	76.28	76.38	0.10	483		LRL	IM	483 (481 not developed) - Changed pick points 56.28 to 76.28, 56.38 to 76.38
WW11-30	82.44	83.22	0.78	480		LRL	IM	
WW11-30	97.07	97.86	0.79	A7		LRL	IM	
WW11-30	113.92	114.82	0.90	A5		LRL	IM	
WW11-30	116.75	116.92	0.17	Coal		LRL	IM	Coal above A3
WW11-30	118.16	118.82	0.66	A3		LRL	IM	
WW11-30	123.91	124.25	0.34	A3		LRL	IM	
WW11-30	135.87	136.18	0.31	A32		LRL	IM	
WW11-30	142.70	142.80	0.10	Coal		LRL	IM	Coal - A1/A0 interpreted to be lower in earlier holes, near 500 seam.
WW11-30	145.27	145.82	0.55	Coal		LRL	IM	Coal - A1/A0 interpreted to be lower in earlier holes, near 500 seam.
WW11-31	0.00	13.60	13.60	Drift		LRL	IM/GCH	*GCH: changed Drift thickness*
WW11-31	13.60	17.80	4.20	*Bullmoose*		GCH		
WW11-31	17.80	18.10	0.30	*Fault*	*Fault, possible*	GCH		*Could also be open joint in bedrock*
WW11-31	18.10	43.30	25.20	*Bullmoose*		GCH		*Characteristic low-gamma signature at top and base*
WW11-31	43.30	49.45	6.15	*Bluesky*		GCH		
WW11-31	49.45	-----	-----	*Gaylard*		GCH		*Top of Division 5 of Gaylard*
WW11-31	49.80	50.20	0.40			LRL	IM/GCH	IM: Coal. *GCH adds: coaly rock*

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

	Metres					Interpretation		
Borehole	From	To	Thickness	Bed	Interpreter's comments	Picked	Checked	Change notes
WW11-31	55.43	55.70	0.27	Bird	?	LRL	IM	Same Bird as picked in WW11-29
WW11-31	75.95	77.00	1.05	170		LRL	IM	*GCH changed thickness; log response indicates clean coal*
WW11-31	110.26	110.91	0.65	150		LRL	IM	
WW11-31	112.80	112.90	0.10	130		LRL	IM	
WW11-31	118.40	118.63	0.23	Coal		LRL	IM	
WW11-31	132.50	132.60	0.10	110		LRL	IM	
WW11-31	134.53	135.12	0.59	100		LRL	IM	
WW11-31	147.46	147.71	0.25	200		LRL	IM	
WW11-31	165.32	166.51	1.19	300		LRL	IM	
WW11-31	182.50	183.59	1.09	400		LRL	IM	
WW11-31	191.40	191.52	0.12	440		LRL	IM	
WW11-31	193.05	193.15	0.10	Coal		LRL	IM	
WW11-31	194.12	195.16	1.04	460		LRL	IM	
WW11-32	0.00	1.39	1.39	Drift		LRL	IM/GCH	*GCH: Drift thickness okay*
WW11-32	4.10	5,00	0.90	170		LRL	IM/GCH	*GCH: lowered roof and floor contact by 0.01 m. Thickness unchanged.*
WW11-32	29.65	30.40	0.75	*Ash*	*Ash band (high gamma)*	GCH		
WW11-32	35.78	36.02	0.24	150		LRL	IM	
WW11-32	37.62	37.72	0.10	130		LRL	IM	
WW11-32	62.50	62.60	0.10	110		LRL	IM	
WW11-32	64.21	64.66	0.45	100		LRL	IM	
WW11-32	78.25	78.57	0.32	200		LRL	IM	
WW11-32	92.41	93.32	0.91	300		LRL	IM	
WW11-32	103.00	103.10	0.10	Fault		IM		Faulted?
WW11-32	103.10	103.35	0.25	300		IM		300 seam repeat "smeared" out by fault? Carbonaceous claystone kick

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

Borehole	Metres				Interpreter's comments	Interpretation		Change notes
	From	To	Thickness	Bed		Picked	Checked	
WW11-32	118.12	118.93	0.81	400		LRL	IM	
WW11-32	125.55	125.65	0.10	440		LRL	IM	
WW11-32	126.81	126.95	0.14	460		LRL	IM	
WW11-32	144.00	144.15	0.15	483		LRL	IM	
WW11-32	153.00	153.10	0.10	481		LRL	IM	
WW11-32	154.61	154.97	0.36	480		LRL	IM	
WW11-32	168.80	169.57	0.77	A7		LRL	IM	
WW11-32	188.48	189.59	1.11	A5		LRL	IM	
WW11-32	192.95	193.07	0.12	Coal		LRL	IM	Coal above A3
WW11-32	194.82	195.09	0.27	A3		LRL	IM	
WW11-32	200.18	200.30	0.12	A3		LRL	IM	
WW11-32	207.04	207.12	0.08	A32		LRL	IM	
WW11-32	219.22	219.72	0.50	Coal		LRL	IM	A1/A0 interpreted to be lower in earlier holes, near 500 seam
WW11-33	0.00	5.00	5.00	Drift		LRL	IM	
WW11-33	8.14	8.51	0.37	150		LRL	IM	150
WW11-33	10.20	10.40	0.20	130		LRL	IM	130
WW11-33	22.00	22.21	0.21	Coal		LRL	IM	
WW11-33	34.90	35.00	0.10	110		LRL	IM	110
WW11-33	36.55	37.29	0.74	100		LRL	IM	100
WW11-33	51.26	51.89	0.63	200		LRL	IM	200
WW11-33	61.90	62.51	0.61	300		LRL	IM	300
WW11-33	64.00	64.10	0.10	Fault		IM		Same fault as WW11-32?
WW11-33	73.09	74.12	1.03	300		LRL	IM	300 Rpt. (?)
WW11-33	87.07	88.52	1.45	400		LRL	IM	400

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

	Metres					Interpretation		
Borehole	From	To	Thickness	Bed	Interpreter's comments	Picked	Checked	Change notes
WW11-32	118.12	118.93	0.81	400		LRL	IM	
WW11-32	125.55	125.65	0.10	440		LRL	IM	
WW11-32	126.81	126.95	0.14	460		LRL	IM	
WW11-32	144.00	144.15	0.15	483		LRL	IM	
WW11-32	153.00	153.10	0.10	481		LRL	IM	
WW11-32	154.61	154.97	0.36	480		LRL	IM	
WW11-32	168.80	169.57	0.77	A7		LRL	IM	
WW11-32	188.48	189.59	1.11	A5		LRL	IM	
WW11-33	138.50	138.73	0.23	A7		LRL	IM	
WW11-33	138.73	139.07	0.34			LRL	IM	HCC [coaly rock or dirty coal] Parting
WW11-33	139.07	139.40	0.33	A7		LRL	IM	
WW11-33	157.59	158.50	0.91	A5		LRL	IM	
WW11-33	161.90	162.00	0.10	Coal		LRL	IM	Coal above A3
WW11-33	164.04	164.20	0.16	A3		LRL	IM	
WW11-33	168.73	168.83	0.10	A3		LRL	IM	
WW11-33	177.41	177.90	0.49	A32		LRL	IM	
WW11-34	0.00	2.30	2.30	Drift	collared in coal?	LRL	IM	
WW11-34	2.30	2.40	0.10	Coal		LRL	IM	Coal
WW11-34	9.56	9.82	0.26	110		LRL	IM	
WW11-34	15.06	15.33	0.27	100		LRL	IM	
WW11-34	27.33	27.65	0.32	200		LRL	IM	
WW11-34	35.62	36.60	0.98	300		LRL	IM	
WW11-34	51.10	52.63	1.53	400		LRL	IM	Changed pick from 51.11 - 52.25 to 51.00 - 52.63
WW11-34	59.15	59.26	0.11	440		LRL	IM	

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

	Metres					Interpretation		
Borehole	From	To	Thickness	Bed	Interpreter's comments	Picked	Checked	Change notes
WW11-34	61.22	61.35	0.13	460		LRL	IM	
WW11-34	82.07	82.28	0.21	483		LRL	IM	
WW11-34	91.03	91.16	0.13	481		LRL	IM	
WW11-34	92.56	92.98	0.42	480		LRL	IM	
WW11-34	99.40	99.50	0.10	Coal		LRL	IM	
WW11-34	101.83	102.32	0.49	A7		LRL	IM	
WW11-34	102.32	102.68	0.36			LRL	IM	Parting
WW11-34	102.68	103.00	0.32	A7		LRL	IM	Consider parting as included in the seam when putting into GEMS
WW11-34	125.06	125.66	0.60	A5		LRL	IM	
WW11-34	127.85	127.95	0.10	A3		LRL	IM	
WW11-34	128.62	128.84	0.22	A3		LRL	IM	
WW11-34	137.46	137.83	0.37	Coal		LRL	IM	Coal - often HCC [coaly rock or dirty coal] kick
WW11-34	140.48	140.65	0.17	A32	missing 5 & 6 ?	LRL	IM	
WW11-34	147.25	147.40	0.15	Coal		IM		Coal - A1/A0 interpreted to be lower in earlier holes, near 500 seam.
WW11-34	150.29	150.50	0.21	Coal		LRL	IM	Coal
WW11-34	175.89	176.91	1.02	A1	Coal	LRL	IM	A1 (?)
WW11-34	176.91	178.42	1.51			LRL	IM	Parting
WW11-34	178.42	180.31	1.89	A0	Possible A1/A0 series	LRL	IM	A0 (?)
WW11-34	180.31	180.55	0.24			LRL	IM	Parting
WW11-34	180.55	180.72	0.17	A0	Possible A1/A0 series	LRL	IM	A0 (?) - Consider parting as included in the seam when putting into GEMS
WW11-34	180.72	183.07	2.35			LRL	IM	Parting
WW11-34	183.07	183.56	0.49	500	Possible A1/A0 series	LRL	IM	500 (?)
WW11-34	183.56	184.12	0.56			LRL	IM	Parting - Changed "to" from 184.18 to 184.12
WW11-34	184.12	184.52	0.40	500	Possible A1/A0 series	LRL	IM	500 (?) - Consider parting as included in the seam when putting into GEMS

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

	Metres					Interpretation		
Borehole	From	To	Thickness	Bed	Interpreter's comments	Picked	Checked	Change notes
WW11-34	184.52	188.32	3.80			LRL	IM	Interseam
WW11-34	188.32	188.42	0.10	520		LRL	IM	520 (?)
WW11-34	188.42	195.32	6.90			LRL	IM	Interseam
WW11-34	195.32	196.00	0.68	541		LRL	IM	541 (?)
WW11-34	196.00	196.53	0.53			LRL	IM	Parting
WW11-34	196.53	196.92	0.39	540		LRL	IM	540 (?)
WW11-34	196.92	197.83	0.91			LRL	IM	Parting
WW11-34	197.83	198.46	0.63	542		LRL	IM	542 (?)
WW11-34	205.15	205.79	0.64			LRL	IM	Removed pick - tool possibly not reading.
WW11-35	0.00	5.90	5.90	Drift		LRL	IM	Changed Drift thickness
WW11-35	25.69	26.00	0.31	Coal		IM		
WW11-35	28.52	29.03	0.51	150		LRL	IM	
WW11-35	31.72	31.82	0.10	130	Unsure if it's another bed or fault?	LRL	IM	
WW11-35	34.41	34.64	0.23	130	Unsure if it's another bed or fault?	LRL	IM	130
WW11-35	36.03	36.42	0.39	Coal	Unsure if it's another bed or fault?	LRL	IM	Coal
WW11-35	43.08	43.20	0.12	110	Fault?	LRL	IM	Changed floor pick from 43.12 - 43.20
WW11-35	49.56	49.79	0.23	100		LRL	IM	
WW11-35	61.38	61.72	0.34	200		LRL	IM	
WW11-35	71.00	71.93	0.93	300		LRL	IM	
WW11-35	83.66	84.61	0.95	400		LRL	IM	
WW11-35	93.29	93.49	0.20	440		LRL	IM	
WW11-35	95.70	95.80	0.10	460		LRL	IM	

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

Borehole	Metres			Bed	Interpreter's comments	Interpretation		Change notes
	From	To	Thickness			Picked	Checked	
WW11-35	114.89	115.15	0.26	483		LRL	IM	
WW11-35	123.54	123.64	0.10	481		LRL	IM	
WW11-35	125.30	125.63	0.33	480		LRL	IM	
WW11-35	132.00	132.20	0.20	Coal		IM		
WW11-35	134.59	135.42	0.83	A7		LRL	IM	
WW11-36	0	17.7	17.7	Drift		LRL	GCH	*Changed Drift thickness*
WW11-36	26.90	27.00	0.10	170		LRL	IM	
WW11-36	29.05	29.70	0.65	Cave	Fault/ Cave in	LRL	GCH	*Changed thickness of fault zone*
WW11-36	38.80	38.90	0.01	*Fault*	*Fault, possible*	GCH		
WW11-36	60.40	60.65	0.25	*Ash*	*Ash band (high gamma)*	GCH		
WW11-36	62.51	62.61	0.10	Coal		LRL	IM	
WW11-36	64.68	64.95	0.27	150		LRL	IM	
WW11-36	65.10	65.15	0.05	*Fault*	*Fault, possible*	GCH		
WW11-36	68.20	68.30	0.10	130	Unsure if it's another bed or fault?	LRL	IM	
WW11-36	69.40	69.60	0.20	130	Unsure if it's another bed or fault?	LRL	IM	
WW11-36	69.90	70.00	0.10	*Fault*	*Fault, probable*	GCH		
WW11-36	73.78	73.98	0.20	Coal	Unsure if it's another bed or fault?	LRL	IM	Coal - Usually HCC [coaly rock or dirty coal]
WW11-36	79.10	79.20	0.10	110		LRL	IM	
WW11-36	79.85	79.95	0.10	110		LRL	IM	
WW11-36	85.15	85.35	0.20	100		LRL	IM	
WW11-36	97.90	98.10	0.20	200		LRL	IM	
WW11-36	108.66	109.65	0.99	300		LRL	IM	
WW11-36	124.40	125.00	0.60	400		LRL	IM	Changed floor pick 124.90 to 125.00
WW11-36	134.90	135.00	0.10	440		LRL	IM	

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

Borehole	Metres			Bed	Interpreter's comments	Interpretation		Change notes
	From	To	Thickness			Picked	Checked	
WW11-36	137.40	137.50	0.10	460		LRL	IM	
WW11-36	149.60	149.70	0.10	Coal		LRL	IM	
WW11-36	154.90	155.15	0.25	483		LRL	IM	
WW11-36	163.30	163.40	0.10	481		LRL	IM	
WW11-36	165.70	166.03	0.33	480		LRL	IM	
WW11-36	173.90	174.00	0.10	Coal		LRL	IM	Picked as "Coal" in other holes
WW11-36	177.30	177.40	0.10	A7		LRL	IM	
WW11-36	177.90	178.04	0.14	A7		LRL	IM	
WW11-37	0.00	11.30	11.30	Drift		LRL	IM/GCH	IM Note: Appears as though the hole verges towards down-dip from ~55 m to 150 m. *GCH adds: changed Drift thickness*
WW11-37	12.80	12.90	0.10	170		LRL	IM	Also, strata seen at the top of WW11-37 are shallower than expected if compared to WW11-36, assuming a ~50 degree dip. Flat-lying bedding was mapped between sites WW11-36 and WW11-37 (drag fold or small anticline?).
WW11-37	40.95	41.15	0.20	*Ash*	*Ash band (high gamma)*	GCH		
WW11037	43.10	43.22	0.12	*Fault*	*Fault, probable*	GCH		*Caliper indicates breakout*
WW11-37	43.22	43.55	0.33	Coal	Fault/Cave in?	LRL	IM/GCH	IM Note: Coal - seen in WW11-36. *GCH adds: dirty coal over coaly rock*
WW11-37	45.12	45.59	0.47	150		LRL	IM	
WW11-37	49.10	49.20	0.10	130		LRL	IM	
WW11-37	50.10	50.40	0.30	130		LRL	IM	
WW11-37	53.60	54.14	0.54	Coal	Where is 110?	LRL	IM	Coal - as seen in WW11-36. Expanded due to oblique intersection with stratigraphy?
WW11-37	86.90	87.10	0.20	110	Fault/Cave in?	LRL	IM	110 - Expanded due to oblique (down-dip?) intersection?
WW11-37	87.40	87.60	0.20	*110*	*Dirty coal*	GCH		*110?*

Table A-2: Lithological interpretation of year-2011 boreholes (continued)

	Metres					Interpretation		
Borehole	From	To	Thickness	Bed	Interpreter's comments	Picked	Checked	Change notes
WW11-37	87.60	88.18	0.58	110	Fault/Cave in?	LRL	IM/GCH	IM Notes: 110 - Expanded due to oblique (down-dip?) intersection? *GCH adds: Fault, probable -- note substantial breakout*
WW11-37	98.69	99.71	1.02	100		LRL	IM	100
WW11-37	133.67	134.27	0.60	200		LRL	IM	200
WW11-37	154.31	155.52	1.21	300		LRL	IM	300 - Intersections seem to return to comparable intervals about here
WW11-37	172.66	172.74	0.08	400	420	LRL	IM	400 - As picked in WW11-36
WW11-37	173.34	173.44	0.10	400	420	LRL	IM	400
WW11-37	186.50	186.60	0.10	440		LRL	IM	
WW11-37	189.21	189.39	0.18	460		LRL	IM	
WW11-37	204.92	205.23	0.31	483		LRL	IM	
WW11-38	0.00	2.00	2.00	Drift		LRL	IM	
WW11-38	16.26	16.46	0.20	740		LRL	IM	
WW11-38	16.83	17.10	0.27	740		LRL	IM	
WW11-38	20.28	20.75	0.47	760		LRL	IM	
WW11-38	21.38	21.53	0.15	760		LRL	IM	
WW11-38	30.11	30.32	0.21	760	780?	LRL	IM	
WW11-38	42.28	42.66	0.38	800		LRL	IM	
WW11-38	47.90	48.00	0.10	Coal		LRL	IM	
WW11-38	70.01	70.41	0.40	900		LRL	IM	
WW11-38	80.94	81.31	0.37	Coal		LRL	IM	
WW11-38	94.63	94.79	0.16	1000		LRL	IM	
WW11-38	95.11	95.46	0.35	1000		LRL	IM	
WW11-38	109.03	109.53	0.50	1020	Possible 1120 see WW09-60	LRL	IM/GCH	*GCH: no 'WW09' series of holes known to exist; maybe 'WC'09-60?*
WW11-38	131.70	131.80	0.10	1110		LRL	IM	

Table A-2: Lithological interpretation of year-2011 boreholes (concluded)

Borehole	Metres: From	To	Thickness	Bed	Interpreter's comments	Interpretation: Picked	Checked	Change notes
WW11-38	147.00	147.48	0.48	1120	Sandstone below see WW09-60	LRL	IM	*GCH: no 'WW09' series of holes known to exist; maybe 'WC'09-60?*
WW11-38	190.50	190.65	0.15	1200		LRL	IM	
WW11-38	192.10	192.20	0.10	1220		LRL	IM	

Notes: IM: Ian MacLeod P.Geo.; LRL: Laura R. LeMay; GCH: C.G. Cathyl-Huhn P.Geo. HCC: 'Highly Carbonaceous Claystone', not 'Hard Coking Coal'

Table A-3: Lithological interpretation of selected year-2012 boreholes

Borehole	Metres: From	To	Thickness	Bed	Interpreter's comments	Interpretation: Picked	Checked	Change notes
WW12-01	0	33.50	33.50	*Drift*		GCH		
WW12-01	33.50	61.10	27.60	Bullmoose		GCH		
WW12-01	62.10	62.30	0.20	Fault	Fault, possible	GCH		
WW12-01	62.30	63.50	1.20	Bullmoose		GCH		
WW12-01	63.50	63.65	0.15	Fault	Fault, possible	GCH		
WW12-01	63.65	67.10	0.45	Bullmoose		GCH		
WW12-01	67.10	67.20	0.10	Ash	Ash band (moderately high gamma)	GCH		
WW12-01	67.20	106.50	39.30	Bullmoose		GCH		
WW12-01	106.50	110.90	4.40	Bluesky	Characteristic low gamma response at top and base	GCH		
WW12-01	110.90	158.36	47.46	Gaylard	Starts in Division 5 of Gaylard; coals present but not yet picked; base of Division 5 probably not reached	GCH		
WW12-02	0	6.75	6.75	Drift		GCH		
WW12-02	6.75	64.40	57.65	Bullmoose		GCH		
WW12-02	64.40	64.50	0.10	Ash	Ash band	GCH		
WW12-02	64.50	91.30	25.80	Bullmoose		GCH		
WW12-02	91.30	91.60	0.30	Fault	Fault, possible	GCH		

Table A-3: Lithological interpretation of selected year-2012 boreholes (continued)

Borehole	Metres			Bed	Interpreter's comments	Interpretation		Change notes
	From	To	Thickness			Picked	Checked	
WW12-02	91.60	110.05	18.45	Bullmoose		GCH		
WW12-02	110.05	110.45	0.40	Ash	Ash band (high gamma)	GCH		
WW12-02	110.45	167.25	56.80	Bullmoose		GCH		
WW12-02	167.25	173.55	6.30	Bluesky	Distinctive low gamma response at top and base	GCH		
WW12-02	173.55	173.70	0.15	Gaylard	Carbonaceous rock	GCH		
WW12-02	173.70	206.30	32.60	Gaylard	Base of Gaylard not reached; coals present but not yet picked; probably does not reach base of Division 5	GCH		
WW12-03	0	6.70	6.70	Drift		GCH		
WW12-03	6.70	13.50	6.80	Cowmoose		GCH		
WW12-03	13.50	13.95	0.45	Green Marker?	In absence of core or cuttings, difficult to confirm	GCH		
WW12-03	13.95	18.25	4.30	Chamberlain	Log suggests interbedded sandstone and siltstone; no coal.	GCH		
WW12-03	18.25	75.10	56.85	Bullmoose		GCH		
WW12-03	75.10	75.45	0.35	Ash	Ash band (high gamma)	GCH		
WW12-03	75.45	203.30	127.85	Bullmoose		GCH		
WW12-03	203.30	203.60	0.30	Ash	Ash band (high gamma)	GCH		
WW12-03	203.60	205.63	2.03	Bullmoose	Probably does not reach base of Bullmoose	GCH		
WW12-04	0	17.35	17.35	Drift		GCH		
WW12-04	17.35	41.50	24.15	Cowmoose		GCH		
WW12-04	41.50	41.90	0.40	Green Marker?	In absence of core or cuttings, difficult to confirm	GCH		
WW12-04	41.90	47.65	5.75	Chamberlain	Log suggests interbedded sandstone and siltstone; no coal.	GCH		
WW12-04	47.65	47.75	0.10	Fault	Fault, possible	GCH		

Table A-3: Lithological interpretation of selected year-2012 boreholes (concluded)

	Metres					Interpretation		
Borehole	From	To	Thickness	Bed	Interpreter's comments	Picked	Checked	Change notes
WW12-04	47.75	48.60	0.85	Cowmoose	Immediate basal section of Cowmoose	GCH		
WW12-04	48.60	48.95	0.35	Green Marker?	In absence of core or cuttings, difficult to confirm	GCH		
WW12-04	48.95	52.25	3.30	Chamberlain	Log suggests interbedded sandstone and siltstone; no coal.	GCH		
WW12-04	52.25	52.35	0.10	Fault	Fault, probable	GCH		
WW12-04	52.35	65.25	12.90	Cowmoose		GCH		
WW12-04	65.25	65.50	0.25	Green Marker?	In absence of core or cuttings, difficult to confirm	GCH		
WW12-04	65.50	69.80	4.30	Chamberlain	Log suggests interbedded sandstone and siltstone; no coal.	GCH		
WW12-04	69.80	122.85	53.05			GCH		
WW12-04	122.85	123.00	0.15	Ash	Ash band (high gamma)	GCH		
WW12-04	123.00	176.33	53.33	Bullmoose	Base of Bullmoose not reached	GCH		
WW12-09	0	18.85	18.85	Drift		GCH		
WW12-09	18.85	62.00	43.15	Bullmoose	Note breakouts down to 24.05 metres; probably weathered or jointed rock	GCH		
WW12-09	62.00	67.20	5.20	Bluesky	Characteristic low-gamma zones at top and base	GCH		
WW12-09	67.20	219.68	152.48	Gaylard	Starts in Division 5; coals and internal details not yet picked	GCH		

Table A-4: Lithological interpretation of CML Boulder c-03-F / WA 15660 well

	Metres					Interpretation		
Well	From	To	Thickness	Bed	Interpreter's comments	Picked	Checked	Change notes
c-03-F	0	10.0	10.0	Drift	Cuttings log has poorly sorted gravel, interpreted as till	GCH		
c-03-F	10.0	24.0	14.0	Falher	Minor angular coal fragments reported in cuttings log	GCH		
c-03-F	24.0	65.0	41.0	Torrens	Entirely behind surface casing; cuttings log notes silty interbeds	GCH		
c-03-F	65.0	109.5	44.5	Spieker	Top of Spieker	GCH		
c-03-F	109.5	110.0	0.5	Ash	Ash band (high gamma)	GCH		
c-03-F	110.0	128.0	18.0	Spieker		GCH		

Table A-4: Lithological interpretation of CML Boulder c-03-F / WA 15660 well (continued)

	Metres					Interpretation		
Well	From	To	Thickness	Bed	Interpreter's comments	Picked	Checked	Change notes
c-03-F	128.0	150.2	22.2	Cowmoose	Top of Cowmoose	GCH		
c-03-F	150.2	150.4	0.2	Ash	Ash band (high gamma)	GCH		
c-03-F	150.4	164.2	13.8	Cowmoose		GCH		
c-03-F	164.2	164.8	0.6	Ash	Ash band (high gamma)	GCH		
c-03-F	164.8	225.3	60.5	Cowmoose		GCH		
c-03-F	225.3	228.1	2.8	Green Marker	Sandstone in cuttings log	GCH		
c-03-F	228.1	237.0	8.9	Chamberlain?	Silty mudstone and sandy siltstone in cuttings log	GCH		
c-03-F	237.0	245.0	8.0	Upper Bullmoose	Top of Upper Division of Bullmoose	GCH		
c-03-F	245.0	245.1	0.1	Fault	Fault, probable; Upper Bullmoose thrust over Cowmoose	GCH		
c-03-F	245.1	248.0	2.9	Cowmoose	Basal part of Cowmoose	GCH		
c-03-F	248.0	249.0	1.0	Green Marker	Chert-pebble conglomerate in cuttings log, marked as Bluesky	GCH		
c-03-F	249.0	256.2	7.2	Chamberlain	Carbonaceous mudstone, siltstone and **coal** in cuttings log; geophysical logs do not show coal; possibly isolated coarse coaly plant trash (driftwood?)	GCH		
c-03-F	256.2	281.1	24.9	Upper Bullmoose	Top of Upper Division of Bullmoose	GCH		
c-03-F	281.1	281.4	0.3	Fault	Fault, probable; Upper Bullmoose thrust over Cowmoose	GCH		
c-03-F	281.4	293.5	12.1	Cowmoose	Basal part of Cowmoose	GCH		
c-03-F	293.5	297.4	3.9	Green Marker	Sandstone in cuttings log; geophysical log confirms	GCH		
c-03-F	297.4	302.8	5.4	Chamberlain	Sandstone and carbonaceous mudstone in cuttings log; geophysical log suggests sandstone and siltstone	GCH		
c-03-F	302.8	375.3	72.5	Upper Bullmoose	Top of Upper Division of Bullmoose	GCH		
c-03-F	375.3	375.8	0.5	Ash	Ash band (high gamma)	GCH		
c-03-F	375.8	399.3	23.5	Upper Bullmoose		GCH		
c-03-F	399.3	400.1	0.8	Middle Bullmoose	Middle Division of Bullmoose; geophysical logs suggest thin band of silty sandstone or sandy siltstone	GCH		
c-03-F	400.1	434.2	34.1	Lower Bullmoose	Top of Lower Division of Bullmoose	GCH		

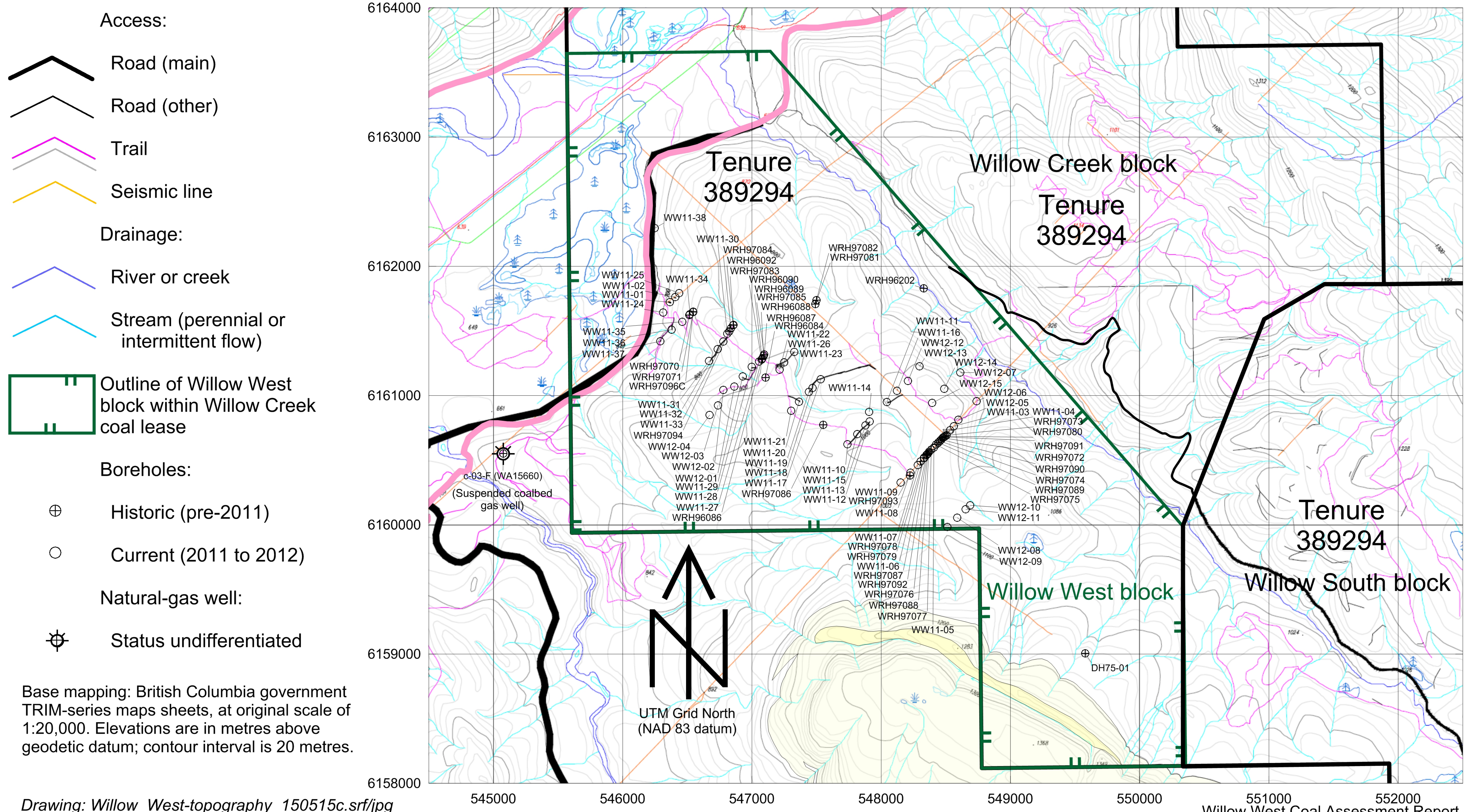
Table A-4: Lithological interpretation of CML Boulder c-03-F / WA 15660 well (continued)

	Metres					Interpretation		
Well	From	To	Thickness	Bed	Interpreter's comments	Picked	Checked	Change notes
c-03-F	434.2	434.4	0.2	Ash	Ash band (high gamma)	GCH		
c-03-F	434.4	455.0	20.6	Lower Bullmoose		GCH		
c-03-F	455.0	455.6	0.6	Ash	Ash band (high gamma)	GCH		
c-03-F	455.6	455.7	0.1	Fault	Fault, possible	GCH		
c-03-F	455.7	488.0	32.3	Upper Bullmoose		GCH		
c-03-F	488.0	488.4	0.4	Ash	Ash band (high gamma)	GCH		
c-03-F	488.4	489.0	0.6	Upper Bullmoose	Basal part of Upper Division	GCH		
c-03-F	489.0	489.8	0.8	Middle Bullmoose	Sandstone in cuttings log	GCH		
c-03-F	489.8	527.7	37.9	Lower Bullmoose	Top of Lower Division of Bullmoose	GCH		
c-03-F	527.7	528.0	0.3	Fault	Fault, possible; may be basal décollement zone	GCH		
c-03-F	528.0	532.3	4.3	Lower Bullmoose		GCH		
c-03-F	532.3	532.6	0.3	Ash	Ash band (high gamma)	GCH		
c-03-F	532.6	537.1	4.5	Lower Bullmoose	Basal part of Lower Division	GCH		
c-03-F	537.1	539.2	2.1	Bluesky	Top of Bluesky; cuttings log has fractured sandstone	GCH		
c-03-F	539.2	539.3	0.1	Fault	Fault, possible	GCH		
c-03-F	539.3	539.75	0.45	Cowmoose	Basal part of Cowmoose?	GCH		
c-03-F	539.75	554.9	15.15	Bluesky	Cuttings log has fractured sandstone at top, underlain by carbonaceous mudstone, siltstone and coal; geophysical log does not show coal, which may be isolated driftwood	GCH		
c-03-F	554.9	556.1	1.2	Bluesky	Basal conglomerate; chert-pebble conglomerate in cuttings log	GCH		
c-03-F	556.1	556.95	0.85	Gaylard Division 5	Top of Division 5 of Gaylard (Top of Gething Formation); roof of Bird Seam? Cuttings log has carbonaceous mudstone	GCH		
c-03-F	556.95	559.6	2.65	Bird	**Coal**	GCH		
c-03-F	559.6	561.2	1.6	Gaylard Division 5	Floor of Bird Seam? Cuttings log has carbonaceous mudstone	GCH		
c-03-F	561.2	561.3	0.1	Fault	Fault, possible	GCH		
c-03-F	561.3	563.0	1.7	Bird	**Coal**; possibly upper leaf of split Bird Seam	GCH		

Table A-4: Lithological interpretation of CML Boulder c-03-F / WA 15660 well (concluded)

Well	Metres			Bed	Interpreter's comments	Interpretation		Change notes
	From	To	Thickness			Picked	Checked	
c-03-F	563.0	563.95	0.95	Parting	Cuttings log has carbonaceous mudstone	GCH		
c-03-F	563.95	564.9	0.95	Bird	**Coal**; possibly lower leaf of split Bird Seam	GCH		
c-03-F	564.9	568.0	3.1	Gaylard Division 5	Cuttings log has carbonaceous mudstone	GCH		
c-03-F	568.0	568.8	0.8	Coaly rock	Cuttings log has coal; geophysical log shows coaly rock	GCH		
c-03-F	568.8	569.55	0.75	Gaylard Division 5	Cuttings log has carbonaceous mudstone and coal; geophysical log does not show coal	GCH		
c-03-F	569.55	570.05	0.5	Ash	Ash band (high gamma)	GCH		
c-03-F	570.05	589.5	19.45	Gaylard Division 5	Cuttings log has siltstone and carbonaceous mudstone	GCH		
c-03-F	589.5	595.8	6.3	Gaylard Division 5	Cuttings log has sandstone; geophysical log suggests interbedded sandstone and siltstone; base not reached	GCH		

Note: cuttings log refers to sample descriptions by Barry Kyba P.Geo., included within well history report of WA 15660.



metres

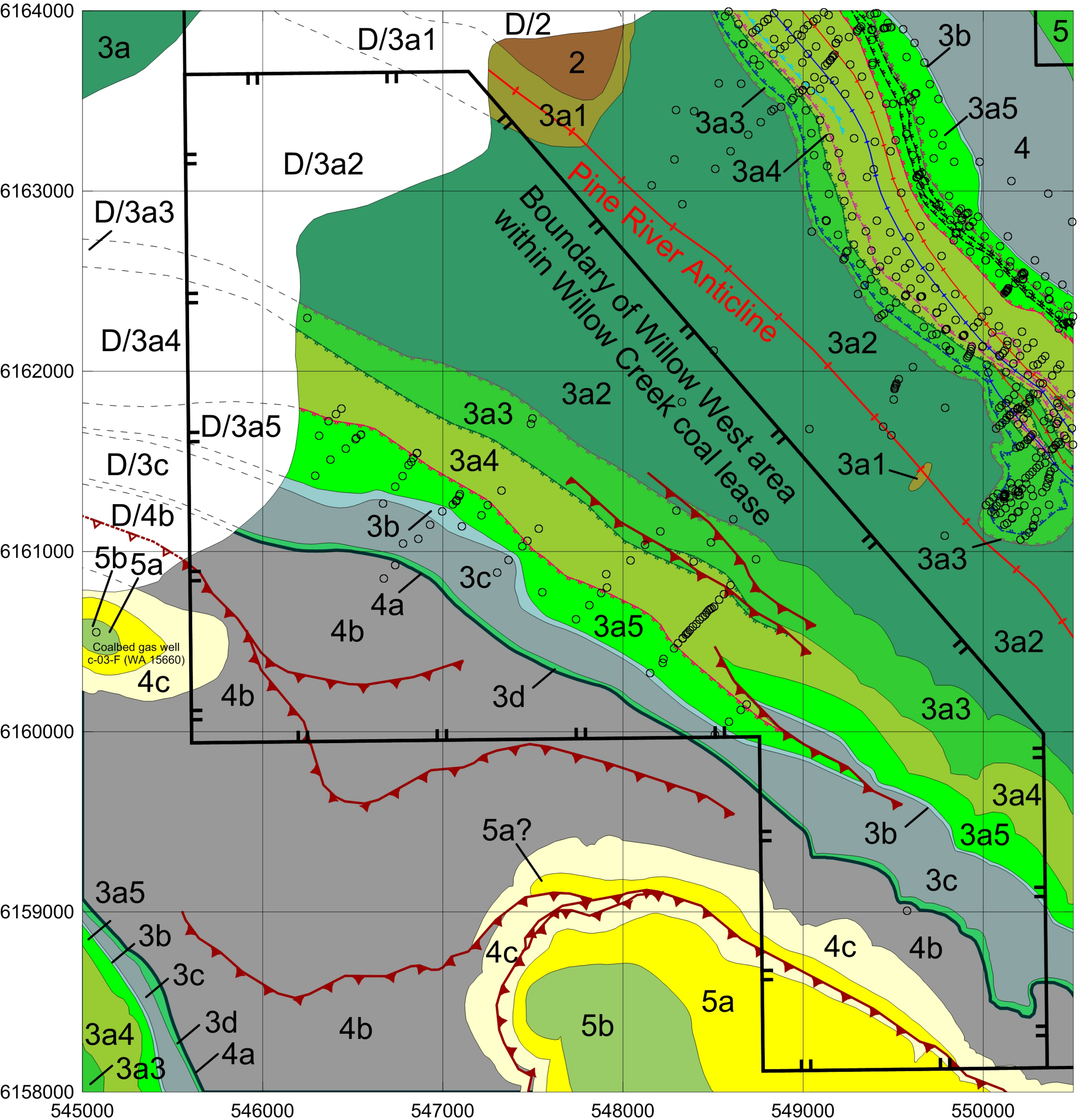
0 1000 2000 3000

Drawing: Willow_West-topography_150515c.srf/jpg
Drawn: C.G. Cathyl-Huhn, P.Geo.(BC) Lic.Geol.(WA) RMSME
Date: 15.May, 2015 Scale: as shown by bar scale
Grid: UTM Zone 10 to North American Datum of 1983, in metres

WALTER ENERGY

Willow West Coal Assessment Report

Map 2-2:
Coal Tenure and Topography



metres

0 1000 2000

Drawing: Willow_West-local-geology-tracing-base-NAD83_150524k.srf/jpg
Drawn: C.G. Cathyl-Huhn, P.Geo.(BC) Lic.Geol.(WA) RMSME
Date: 24.May, 2015 Scale: as shown by bar scale
Grid: UTM Zone 10 to North American Datum of 1983, in metres

STRATIGRAPHIC LEGEND:
QUATERNARY
- D — Alluvium and colluvium -- fluvial and glaciolacustrine deposits; moraines; talus; possible landslide deposits

FORT ST JOHN GROUP (Albian)
- 5 — Gates Formation:
  - [not present] — Notikewin Member -- siltstone, sandstone and conglomerate; minor coal [not present in map-area]
  - 5b — Falher Member -- sandstone, conglomerate and siltstone, minor coal
  - 5a — Torrens Member -- sandstone; minor siltstone
- 4 — Moosebar Formation:
  - 4c — Spieker Member -- siltstone, sandstone; minor mudstone
  - 4b — Cowmoose Member -- mudstone, minor tuff and ironstone
  - 4a — Green Marker -- erosive-based, locally-pebbly, glauconitic mudstone and sandstone
  - 3d — Chamberlain Member -- sandstone and siltstone
  - 3c — Bullmoose Member -- siltstone and sandstone; mudstone; minor tuff
  - 3b — Bluesky Formation -- glauconitic sandstone and gritstone; siltstone and mudstone

BULLHEAD GROUP (Hauterivian to Early Albian)
- 3 — Gething Formation:
  - 3a — Gaylard Member -- siltstone, sandstone and coal; minor conglomerate, minor tuff
    - 3a5 — Division 5 -- siltstone, sandstone and mudstone; coal (zones 1, 2, 3 and 4)
    - 3a4 — Division 4 -- siltstone, mudstone and sandstone; coal (zones A, M, 5 and 6)
    - 3a3 — Division 3 -- sandstone and siltstone; minor mudstone; coal (zones 7 and 8)
    - 3a2 — Division 2 -- siltstone and mudstone; minor sandstone and coal (zones 9 through 12?)
    - 3a1 — Division 1 -- sandstone; minor siltstone, mudstone, and conglomerate
- 2 — Cadomin Formation -- sandstone; minor conglomerate

MINNES GROUP
- 1 — [Older clastic sedimentary rocks -- present only at depth, not known to outcrop or subcrop within map-area]

N

Coal Zones:
- No.1 zone
- No.2 zone
- No.3 zone
- No.4 zone
- A-zone
- No.5 zone
- No.6 zone
- No.7 zone
- No.8 zone

not shown owing to sparse control
- No.9 zone
- No.10 zone
- No.11 zone
- No.12 zone

Structure:
- Anticlinal trace
- Synclinal trace
- Thrust-fault (with barbs on overthrust plate)

Control:
- Borehole

WALTER ENERGY

Willow West Coal Assessment Report

Map 2-3: Bedrock geology of Willow West block